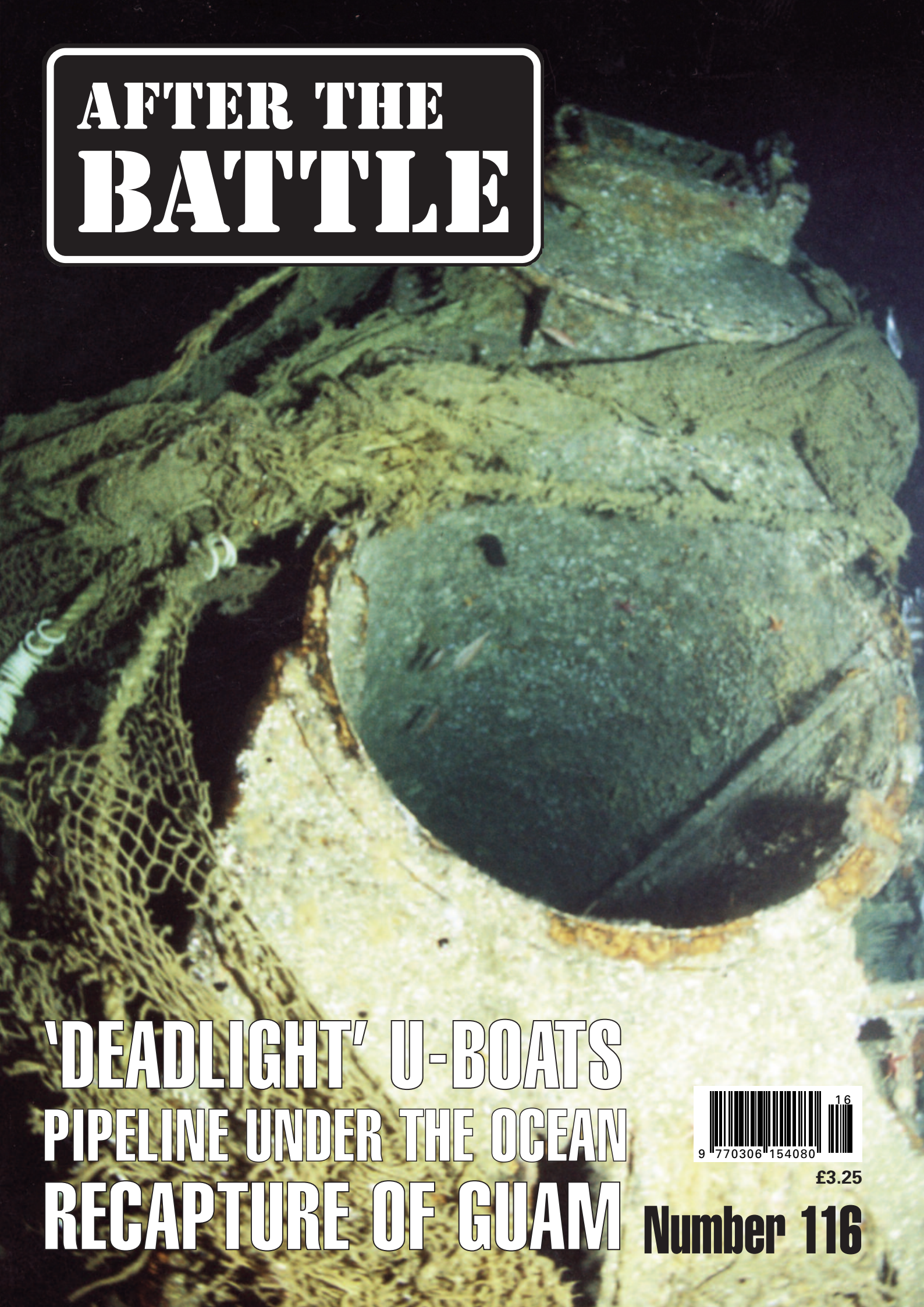
AFTER THE BATTLE



'DEADLIGHT' U-BOATS

PIPELINE UNDER THE OCEAN

RECAPTURE OF GUAM

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Number 116

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Front cover: The wreck of the *U-218* — a rare Type VIID minelaying variant — on the bottom of the Atlantic at a depth of 60 metres off the coast of Ireland. (Innes McCartney)

Centre pages: Essex defences investigated by Fred Nash.

Back cover: *Top:* The Heroes Memorial Monument on Skinner's Plaza in Agana, the capital of the island of Guam. *Bottom:* The War Dogs Cemetery at Yigo. (Marty Black)

Acknowledgements: The Editor is indebted to the following for their help in the preparation of the feature on Pluto: Bob Aspinall, Museum in Docklands; Jonathan Catton, Thurrock Museum; David Davies, Batterie Todt Museum; Steve Johnson; David List; Bob Mitchell, Pirelli Cables; D. J. Moncaster, Port of Tilbury; Fred Nash; David Oliver, AEI Cables Ltd; Bernard Paich; Adrian Searle and especially to Robin Brooks who initiated the project many years ago.

Photo Credits: IWM — Imperial War Museum, London; MD — Museum in Docklands; NAC — National Archives of Canada; USNA — US National Arichives.

Following the defeat of the British Expeditionary Force In France in June 1940, the Petroleum Warfare Department was set up in Britain on July 9 under Major-General Donald Banks *(left)***, formerly Deputy Adjutant-General with the 50th (Northumbrian) Division. The immediate threat of a German invasion had prompted schemes for using the accumulated stocks of petrol and oil to defend Britain. Novel experiments followed: from the creation of flame traps on roads and beaches to the use of fire-ships . . . to attempts to set the sea on fire . . . and massive flame-throwers to burn aircraft from the sky** *(right)***. (IWM) Although many of the ideas were fanciful, nevertheless they had a huge propaganda value as it was policy to make no secret of the fact that any invasion would be met with flame defences. And incidents like that described by James Nice at Shingle Street (see *After the Battle* No. 84), whether real or imaginary, led to rumours that the British were preparing 'to burn the invaders back into the sea'.**

Yet all this was a far cry from the day in 1942 when Admiral Lord Louis Mountbatten, head of Combined Operations, posed the question to Geoffrey Lloyd, the Secretary for Petroleum, whether it would be possible to run a pipeline under the Channel to supply petrol to support an Allied invasion of the Continent. 'The beaches and anchorages are likely to be heavily bombarded and oil tankers are so scarce that the whole operation may be rendered impracticable if safe sources of oil cannot be assured.' Initially, supplies would have to be brought ashore in the ubiquitous Jerricans — the robust containers copied from the German design after the British two-gallon tins were shown to be much inferior during the North African campaign. *Above:* **Here US troops practise unloading gasoline during the pre-D-Day manoeuvres at Slapton Sands in April 1944 (see *After the Battle* No. 44). (USNA)**

PLUTO: PIPELINE UNDER THE OCEAN

In the plans finalised for the Normandy landings, fuel supplies during the initial phase (D-Day to D+21) were to go across in 4-gallon containers in 400-ton carrier vessels called 'Chants' which could ship petrol either packed or in bulk. Their American equivalent was the 600-ton 'Y' tanker which arrived in Britain in substantial numbers during the spring of 1944. Because no port facilities were likely to be found in working order for ocean-going tankers, the intention was to switch these very small tankers from packed supplies to bulk supply within 15 days of landing, with concrete barges of about 180-tons capacity towed across to provide storage. To discharge ocean-going tankers as quickly as possible from off the open shore, a system of floating or submerged pipelines code-named 'Tombola' was developed, connecting up with the vessels at moorings to be put down about a 1,000 yards out east and west of the small fishing port of Port-en-Bessin. It was planned for work to start on Tombola five days after D-Day, to be completed by D+9. Two other moorings were to be put down off Cherbourg as soon as the port was captured. Pluto (an acronym of Pipeline Underwater Transport of Oil, not the popularly-accepted Pipeline Under the Ocean) would bring across supplies to France as a direct extension of the British fuel pipeline network, linking with pipelines laid behind the advancing armies on the other side of the Channel.

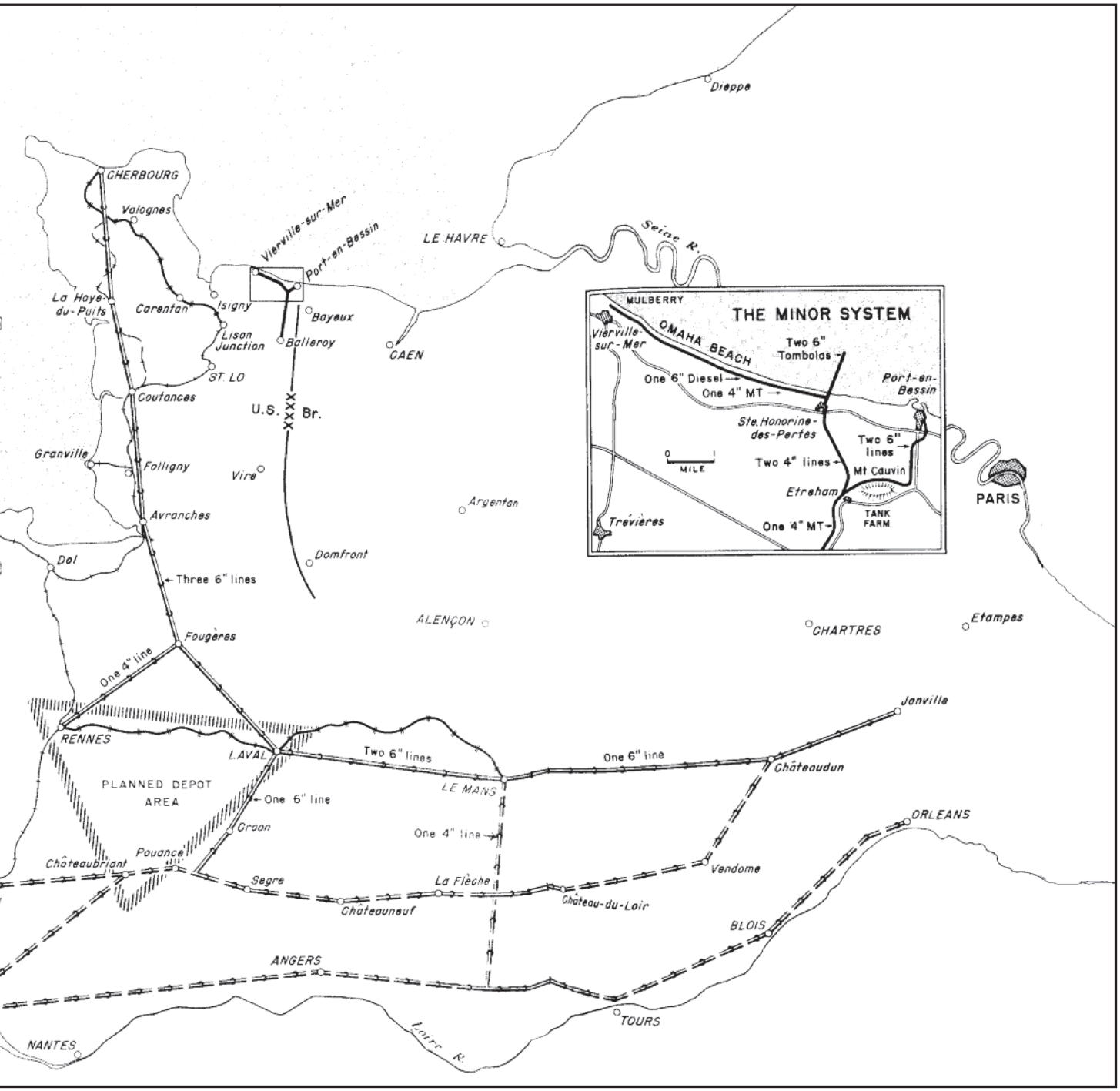
To sustain the massive invasion force when it broke out of the beach-head, it was estimated that there would be a daily requirement for 10,000 tons of fuel and it was hoped that 40-50 per cent of this might be able to be pumped across the Channel. These pictures show troops pushing forward out of the lodgement area: American troops in Montebourg *(above)* **and Canadians in Bretteville** *(below)*. **(USNA/NAC)**

At the joint US-British harbour at Port-en-Bessin, which lay on the boundary between the two forces, two 'Tombola' discharge points were provided. As shown in this picture, the first pipeline was for smaller tankers which could dock against the mole while the other was buoyed 1,000 yards out to sea to permit the transfer of petroleum from larger vessels. (USNA)

TOMBOLA

The entire fuel supply plan for Operation 'Overlord' centred on the two big pipeline systems, designated as the Major and Minor Systems. The Minor System, scheduled to be constructed first, included facilities for receiving. storing and dispensing bulk petrol, oil and lubricant (POL) products in the Port-en-Bessin—Ste Honorine-de-Pertes—Balleroy area. It was to consist of tanker berthing facilities and unloading lines, onshore booster stations, inland tank farms (for storage), pipelines, pumping stations and dispensing facilities. Tanker deliveries were to be discharged through two receiving points.

Where the Western Mole (the Quay Letournier) had been damaged by landing craft during the great storm which hit the beaches on June 19, engineers improvised a suspension support to take the lines over the breach. (USNA)



Storage tanks, covered with camouflage netting, were set up beside the ruins of the town's tuberculosis sanatorium. (IWM)

Left: **Jean Paul Pallud did well to find this spot as there was no clue at all on the original caption, other than that the location was stated as being 'five miles inland'! It continued: 'The pipeline wends its way towards the storage tanks following roads and across fields'. (USNA)** *Right:* **Jean Paul: 'Another difficult research! I found that the two pictures were taken near Etréham where the pipeline ran along the D123. This shot was taken near a place called Fosses Soucy . . .**

British and American forces jointly were to use Port-en-Bessin, a British-controlled port with berthing facilities, as a discharge point for tankers carrying both motor vehicle and aviation fuel. Discharge was to be through two 6-inch lines, delivering both to the British and, through booster pumps, to the US tank farm at Mt Cauvin (near Etréham), about two miles distant from the port.

Ste Honorine-de-Pertes, two miles to the west and a convenient offshore anchorage, was to be the other receiving point, used for the receipt of motor vehicle and diesel fuel for US Army and Navy use. Discharge at that point was to be effected via two 6-inch ship-to-shore underwater lines (called Tombolas), and delivery was to be made to the Ste Honorine storage system, and by pipeline to the Navy fueling station at the site of the artificial Mulberry harbour. The Ste Honorine storage capacity was to total 20,000 barrels, the Mt Cauvin tank farm 24,000 barrels. This much of the Minor System was to be completed and in operation by D+10.

Within the next six days, pipelines were to join the Ste Honorine storage system with the lines at Mt Cauvin, and from this point a 4-inch line was to be constructed to Balleroy, about 13 miles to the south. Terminal storage tanks with a capacity of 6,000 barrels were to be erected at Balleroy, which, like Mt Cauvin and Ste Honorine, was to have dispensing facilities both for canning and for loading tanker lorries.

The entire project involved the construction of 27 miles of pipeline with the necessary booster stations and fittings, and tank storage for 54,000 barrels. Since there were no known commercial facilities in the area the entire system was to be newly constructed.

While the Minor System was designed to meet the Allies' needs for bulk POL in the intitial stages of 'Overlord', the biggest share of bulk deliveries was eventually expected to be made through the larger and more permanent system based on Cherbourg, known as the Major System. This, like the Minor, was to consist of discharge points, storage facilities and pipelines, but it was conceived and planned on a much larger scale and, when completed, was to have many times the capacity of the earlier development east of Omaha Beach. The outstanding features of the Major System were the large discharge capacities at Cherbourg, the long pipelines, and the enormous storage capacities to be developed along the pipeline route. Deliveries at Cherbourg were to be made principally via tanker discharge alongside the Digue de Querqueville. Five 6-inch lines were planned to handle those deliveries.

Modest as was the Minor System as compared with the one based on Cherbourg, it assumed enhanced importance as D-Day drew near. The change in tactical plans made only a week before D-Day not only affected the plans for the phasing in of combat and service units but also caused a revision in the estimated capture date of Cherbourg, setting it back one week to D+15. It therefore had a special significance for the supply of POL. The POL plan relied heavily on the capture of Cherbourg and the early construction of receiving and dispensing facilities there so that the scheduled transfer from packaged maintenance to bulk maintenance could be made by D+21. Any delay in the capture of Cherbourg set the POL plan back proportionately. A week's delay would cause a shortage of 31,400 tons of estimated maintenance and reserve requirements.

To make up this deficit, either additional quantities of packaged POL would have to be introduced to offset the delay in bulk deliveries, or additional bulk-receiving facilities would have to be provided. After discussing several possibilities, it was decided on May 29 that the best solution was to increase the bulk capacity of the Minor System. Meeting maintenance requirements with packaged POL would have required adjustments of the whole supply phasing programme. It was decided rather to increase both the receiving and storage capacity in the Port-en-Bessin—Ste Honorine—Balleroy area, and to make a special allocation of shipping to bring an additional 700 tons of POL construction materials over the beaches for this purpose at an early date.

Plans for the delivery of petrol and other petroleum products proved quite adequate in view of the slow rate of advance, the short lines of communications, and the resulting low consumption. Bulk deliveries of fuel were scheduled to begin on D+15, but construction of the Minor Pipeline System was delayed by difficulties in delivering construction materials, all of which had to arrive over the beaches or through Port-en-Bessin. POL construction materials were mixed with other cargo on several vessels and in the early confusion and competition for priorities, did not arrive as scheduled. A limited quantity of materials was gathered together very shortly, however, and the US 359th Engineer General Service Regiment began work on D+7, although many items were still unavailable.

Just before D-Day, when the discovery of additional enemy forces in the invasion area indicated that the capture of Cherbourg would be delayed, thus enhancing the impor-

. . . and the second picture a kilometre further west in front of the Ferme du Capitaine.' (USNA)

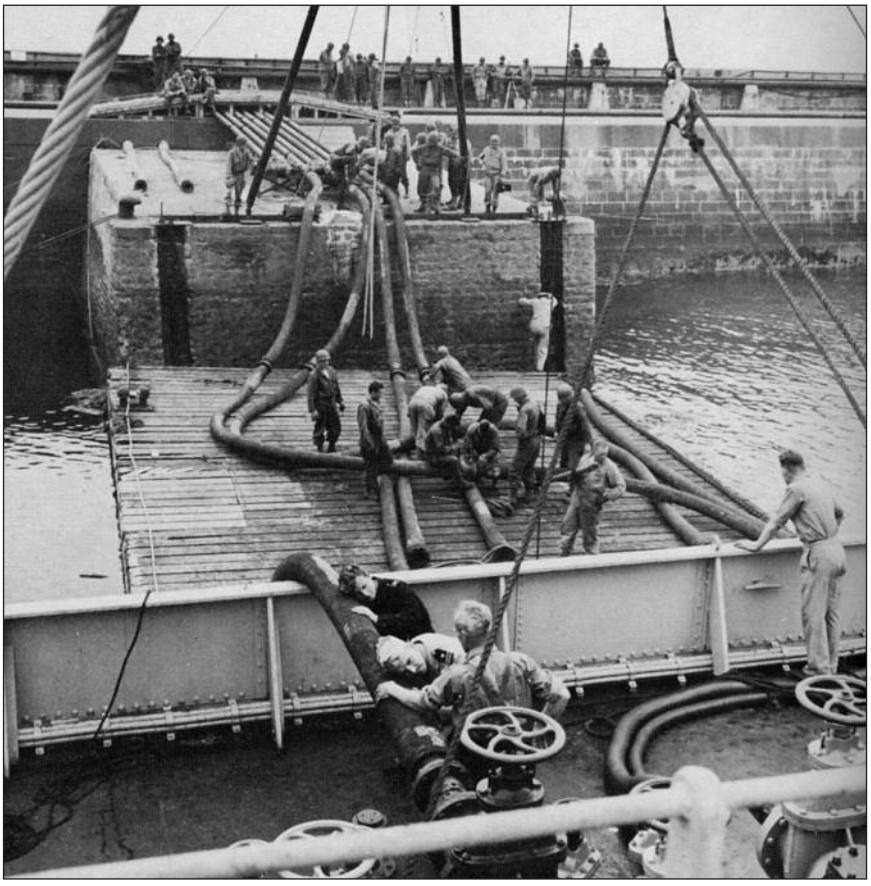
tance of the Minor System, the British 21st Army Group had fortunately made a special allocation of LCT lift to bring in additional construction materials. This cargo began arriving on D+9 and was routed to Port-en-Bessin, where it was promptly unloaded.

The POL plan benefitted by another favourable development. Previous inteligence had indicated that only the east mole at Port-en-Bessin could be used for discharge and that only small tankers of 350-tons' capacity could be handled. On arrival the Allies found that both the west and east moles could be used, one for the British and one for the Americans, and that tankers of up to 1,300-tons' capacity could be received. Eventually it was therefore possible to develop intake capacity of some 2,000 tons per day instead of the 700 originally estimated. This was most fortunate in view of the increased burden put on the Minor System during the prolonged period required to clear the port of Cherbourg.

Meanwhile construction of the facilities at Ste Honorine also proceeded, although plans for a third Tombola were cancelled because of terrain difficulties. Operation of the two underwater lines was actually restricted to fair weather because of difficulties in mooring tankers and connecting pipeheads in rough seas. Reconnaissance of the port areas shortly after the landings also resulted in some change in the siting of the tank farms. Many of the sites selected from the contour maps before the landings were unsuitable, primarily because of unfavourable gradients. The number and size of tanks placed at the ports were therefore held to a minimum, and the main storage was sited on better ground at Mt Cauvin, near Etréham.

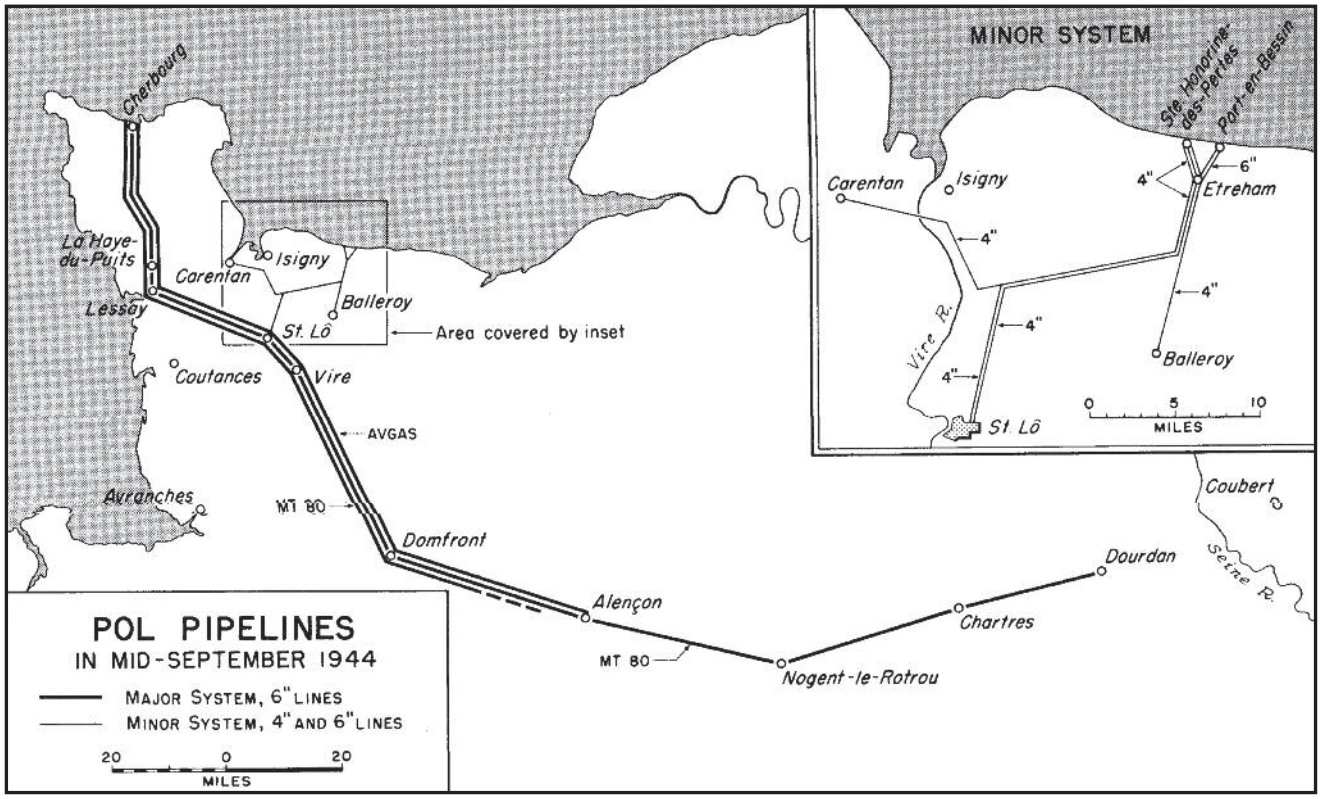
Construction of the pipeline inland from Ste Honorine was delayed somewhat by the necessity of clearing thickly-sown minefields in the area. Several casualties were sustained in this operation, but losses were undoubtedly kept down thanks to information provided by a former French Army captain on the location of mines both inland and offshore. He had witnessed the sowing from his home near the beach.

Construction of the Minor System progressed steadily and was far enough advanced for the US 786th Engineer Petroleum Distributing Company to begin operations on June 25 when the first bulk cargo of MT80 motor fuel was received, about nine days behind the planned schedule, at the Mt Cauvin tank farm. More than enough petrol in containers was on hand in Normandy to bridge the gap, inasmuch as vehicular mileage had been much less than expected in the limited area of the lodgement.



Whereas the Port-en-Bessin facilities — called the 'Minor' System — were designed to cater for the initial stages of the invasion, it was to be followed by the 'Major' System via Cherbourg but the port did not fall into Allied hands until June 27. Although work began immediately to clear the harbour, fuel was to be brought ashore via the long outer mole — the Digue running out to sea from Querqueville — and on July 3 the first ship-to-shore pipeline was brought into use. This is the *Empire Traveller* discharging on July 25. (USNA)

The pipes running at right-angles on the left lead from the tanker berth, well clear of the wreckage in the main harbour. (USNA)



Because of the delay in the capture of Cherbourg, the Minor System assumed even greater importance than expected. It was expanded beyond the original plans after the port was captured because the number of obstacles in the harbour promised to delay still further the use of the Querqueville mole for tanker deliveries.

Pipelines were extended from the Mt Cauvin tank farm to St Lô for both MT80 and aviation fuel, and a branch line for it was laid to Carentan to take advantage of existing facilities there. Eventually the Minor System had 70 miles of pipeline instead of the planned 27. Additional tankage was also constructed to give the system a storage capacity of 142,000 barrels instead of the planned 54,000. Because of rough sea conditions at the Omaha Beach fueling station, the Ste Honorine-des-Pertes installation was not used by the Navy as intended, but was turned over to the Army to be used exclusively as an MT80 receiving and storage terminal.

The Minor System was intended to deliver a total of about 6,000 barrels per day of MT80 and aviation fuel combined but by the end of July the output was double that figure. At that time the US First Army was consuming about 400,000 gallons (9,500 barrels) of motor fuel alone each day. Though originally scheduled to have served its purpose by D+41, the Minor System was compelled by tactical conditions to continue in operation at maximum capacity for many weeks to come. For a 12-day period in September its daily issues averaged 18,000 barrels.

By January 1945, millions of gallons of petrol were stored on the quayside — the supply pipelines can be seen running up from the bottom of the picture. But at this point in the story we must take a step backwards in time to look at the alternative method of supply . . . via Pluto, the code-names for the relative parts of the project conjured from Walt Disney characters too.

Although the idea of Pluto (the acronym either stands for Pipeline/s Under The Ocean or, as it appears in some sources, Pipeline Underwater Transport of Oil) may have originated with Lord Louis, its development was due to the efforts of these three men: Arthur Hartley *(left)* **from the Anglo-Iranian Oil Company; H. A. Hammick** *(centre)*, **Iraq Petroleum Company, and B. J. Ellis** *(right)* **of Burmah Oil.**

PLUTO

As an ambitious adjunct to the supply arrangements for the Normandy invasion — to supplement but not supplant tanker supplies — Pluto had much to commend it as an idea worth exploring; most obviously because it was less vulnerable than shipping to attack and to bad weather, while reducing dependence on vulnerable storage arrangements on the French coast and exposing fewer tankers to risk in the Channel. Underwater pipelines existed at ports and over short runs, but the distance involved in laying one across the Channel, with its tides and strong currents, placed the project in an altogether different category. The tides and the possibility of air attack meant that a pipeline would have to be laid quickly preferably overnight in a single operation, and would therefore have to be made up into a continuous length beforehand. Technically, it was a leap in the dark.

Early in the war, the idea of a cross-Channel oil pipeline from France to Britain had been regarded as impracticable. That was the general tenor of the response from various Whitehall departments to suggestions for such a pipeline which were sent in by people — mostly engineers — wishing to contribute towards the successful prosecution of the war. In fact, the earliest of these suggestions was received before the war, in October 1938. At that time, almost half of Britain's oil supplies came through the Mediterranean, the thinking behind these suggestions therefore was that by discharging cargoes at French Mediterranean ports and transporting the oil across country to the Channel ports (the idea of an overland pipeline does not seem to have been contemplated) and by pumping it by undersea pipeline to the British coast, this would safeguard fuel imports and prevent tanker losses in home waters.

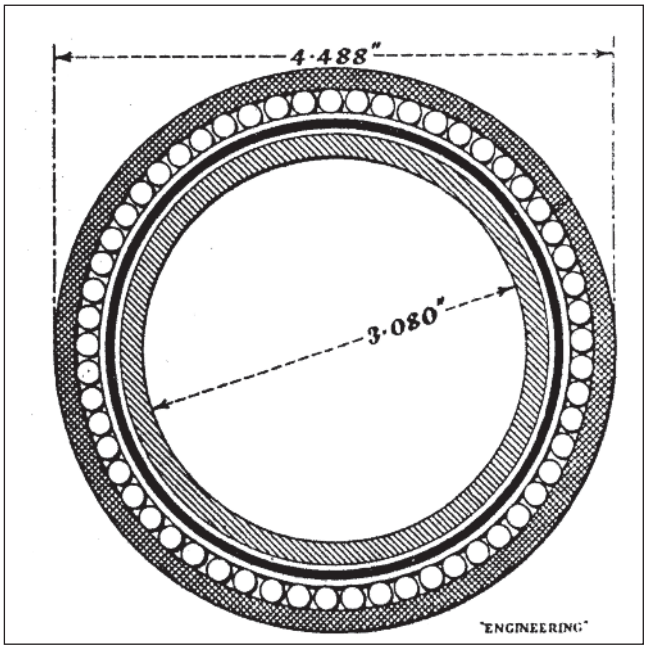
Two of the suggestions envisaged the use of a rubber pipeline, and one of these proposed that it could be laid by existing cable-laying ships, to be jointed on board and apparently looped through boosters on a stationary vessel or structure. The technical problems (though not in theory insuperable) ruled this out, apart from the difficulties of pumping low viscosity oils through narrow-bore pipes. Upkeep was another factor against a pipeline—the potential for damage included anchors fouling the line, depth-charges, friction on rocks and the sea-bed, the failure of joints, and so on. There was concern that a pipeline could easily be destroyed by the enemy should its location become known; that repairs would be difficult to carry out and considerable losses of oil could be expected beforehand; that it could be knocked out by the pump houses being bombed. The lack of enthusiasm for the idea also extended to the cost of building storage tanks in France and of transportation, rail delays were considered inevitable, and there was always the possibility of the Mediterranean being closed.

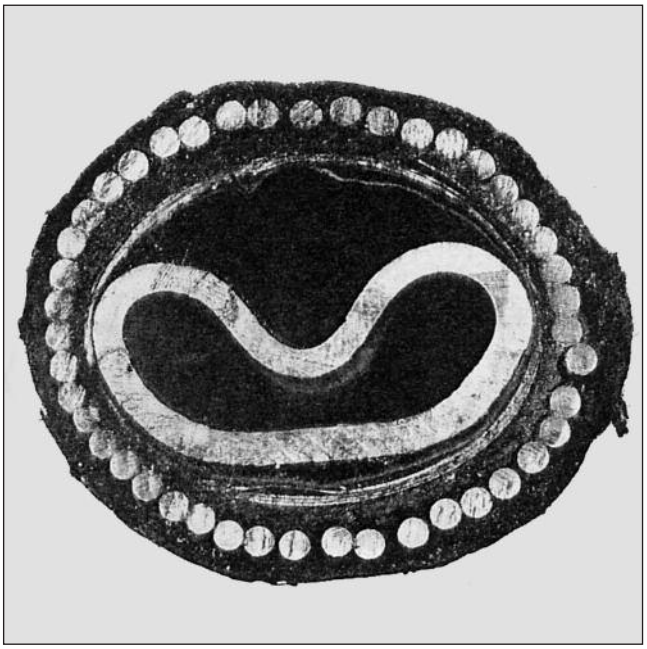
By the spring of 1942, the reversal of Britain's fortunes — the fall of France and the expulsion of the British Army from the Continent — had led to serious consideration of the idea of a cross-Channel pipeline as a means of supply for the forces which were ultimately to re-enter the mainland. Under Combined Operations Headquarters, planning for this assault embraced all manner of innovative projects for an operation that was gigantically novel. The 'Mulberry' floating harbour and the 'Pluto' undersea pipeline were to become in due course probably the most widely known, and while the credit belongs to the Chief of Combined Operations, the youthful Vice-Admiral Lord Louis Mountbatten, for enthusiastically adopting and backing new ideas certain of his staff were not slow to detect a tendency to claim them as his own!

So the story goes, as told by the head of the Petroleum Warfare Department (not to be confused with the Petroleum Department and only later involved in the project), it was at a flame-throwing demonstration at the PWD establishment at Moody Down in Hampshire that Mountbatten had turned to the Petroleum Secretary, Geoffrey Lloyd, and posed the question: 'Could you run a pipeline under the Channel to supply oil when we invade?'

Pluto (the code-name superseded the former 'Cables' and 'Eel') was developed by the Petroleum Department in conjunction with the Combined Operations Experimental Directorate, co-ordination of the project being undertaken by the department. In June 1942 this department, which was loosely subordinate to the Board of Trade, became a division of the newly-founded Ministry of Fuel and Power, with Geoffrey Lloyd as one of two Parliamentary Secretaries attached to the Ministry, and the now Petroleum Division continuing to function in virtual independence under him.

The headquarters of the Petroleum Warfare Department, under whose auspices Pluto was produced, were located in Westminster House in Dean Stanley Street, Millbank. The building is now used in part by Lloyds TSB bank.

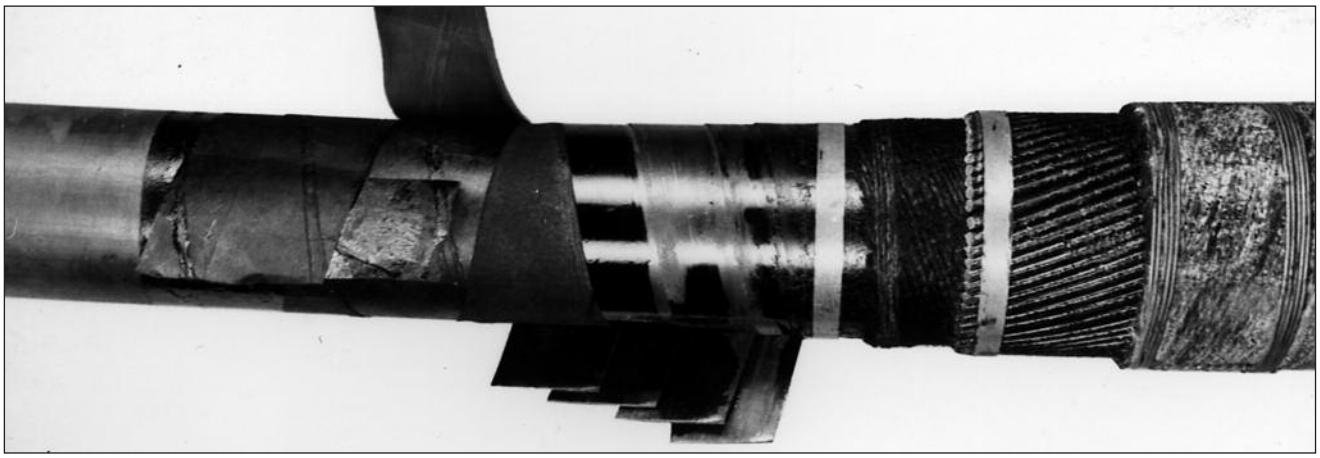




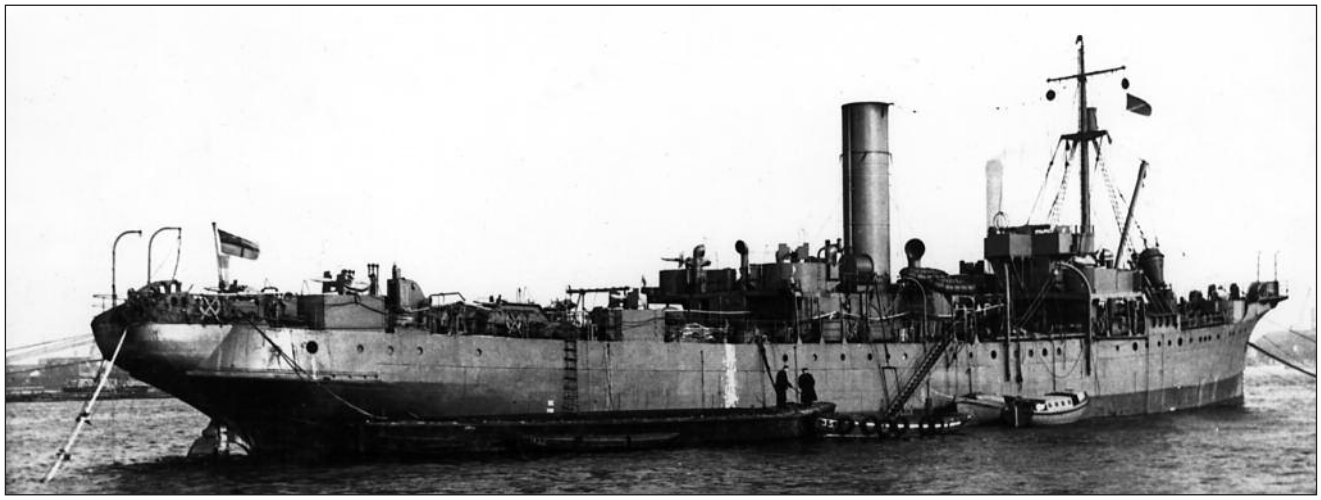
Arthur Hartley takes up the story: 'I was told of the requirement when I visited the Petroleum Department on April 15, 1942. I suggested the only chance of success would be to make a pipe in one complete length, so as to lay it across without stopping and at sufficient speed to get across the strong tidal currents. This would mean using a small-diameter pipe owing to the bulk and weight, but I then thought of the way in which a difficult pumping problem through hilly country in Iran had been solved. The unusually small internal diameter of 3 inches had been chosen, and by working at the very high pressure of 1,500lb per square inch, more than 100,000 gallons, or the equivalent of 25,000 Jerricans a day, were being delivered a distance of 40 miles from pumping station to pumping station. The next morning I saw Dr H. R. Wright, Managing Director of Siemens Bros. & Co., Ltd at Woolwich, and at once he agreed to make a trial length of cable, armoured with steel tape and wire, but without the communicating wires and conducting insulation, and it would start with the usual lead covering as an inner lead pipe impervious to petrol. It would be prevented from bursting by steel tapes and would be held together longitudinally by the steel wires. Even at this early stage, it was realised that secrecy would be essential and it was decided to use the word cable rather than pipe, and the code-name 'Hais' was chosen, standing for Hartley Anglo-Iranian Siemens.

The first 200 yards were ready for test in a week but it was only 2 inches in diameter (internal) so it would only deliver about 30,000 gallons a day across the 20 nautical miles then visualised. The Anglo-Iranian Oil Company was called in to arrange the manufacture of further lengths and prepare a complete test programme. Siemens, without waiting for official orders or priorities, quickly produced more cable which was laid as a loop in the Medway at Chatham on May 10. Failures occurred on this length after two days' pumping, and the faulty portions were recovered and examined by W. T. Henley's Telegraph Works Co. Ltd of Dorking, Surrey, who had, at Siemens' suggestion, been brought in to provide more manufacturing capacity. Siemens and Henleys then combined their research and design facilities and further lengths of 2-inch cable were ordered from both makers with four layers of steel tape instead of two. Test lengths of both firms' manufacture were laid in deep water off the Clyde. Siemens' length was laid first filled with air under only atmospheric pressure. On test, after recovery from the depth of about 200 feet where the external pressure on the cable was 90lbs per square inch, the lead pipe was found to have been pressed in on itself into a kidney shape *(right)* **by the external water pressure. Henleys' was laid full of water under 100lbs psi to balance the external sea pressure and was completely successful.'**

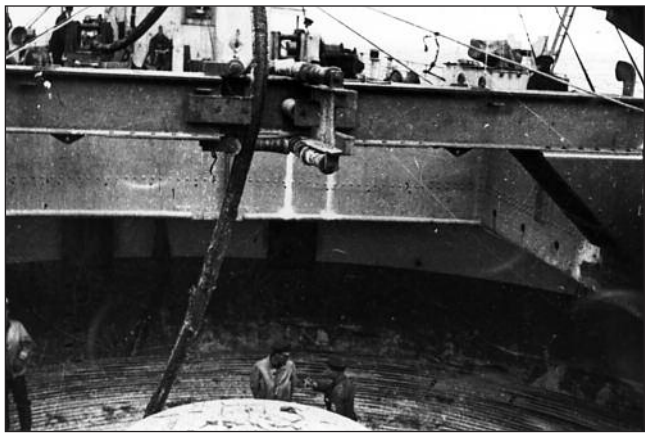
To solve the problems of laying a continuous length of underwater pipeline overnight, two solutions were adopted. The first, put forward by the chief engineer to the Anglo-Iranian Oil Company, Arthur Hartley, was for a lead cable, somewhat like a submarine telegraph cable, without the cores and insulation, to be laid from a cable ship. This was called 'Hais', a word formed from the name of its originator and the two main companies, Anglo-Iranian Oil and Siemens Brothers, which co-operated in manufacturing it.



'While the manufacture and testing of 2-inch cable had been proceeding, experiments were made with larger diameters, and it was proved that a cable of 3 inches in internal diameter (4½ inches external *(top left)***) could be made with existing facilities and could be handled by the ship's machinery with only minor modifications. A 3-inch cable would deliver about 2¾ times more petrol than a 2-inch cable, and it was therefore decided to stop the manufacture of the 2-inch and concentrate on the 3-inch. The lead wall was 0.195in thick. This was covered with two layers of paper tape coated with a petroleum compound, then overlaid with bitumen cotton tape. Four layers of mild-steel strip followed with a layer of tarred jute yarn as a bed for the outer armouring of 57 galvanised steel wires. These were finally covered with two more layers of tarred jute yarn.'**

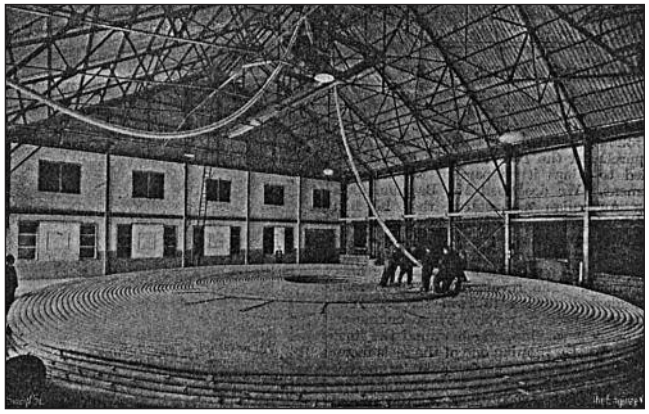


In order to retain the pressure within the pipe during handling, storage and laying, special 'bursting disks' of thin copper were incorporated in each joint. These would retain the water at up to 200psi but would burst at the operating pressure of between 750 and 1,500psi. Arthur Hartley: 'Consideration had meanwhile been given to the methods to be adopted for laying the cable in actual operation, and it was early realised that special cable ships would have to be equipped to carry a sufficient length of this unusually heavy cable, and there still remained the problem of dealing with the shore ends in the shallow water, into which the cable ship could not approach. The Admiralty and the Ministry of War Transport made available the SS *London,* a coaster of 1,500 tons, and she was fitted out and renamed HMS *Holdfast* *(above)* under direction of the Director of Naval Construction with Johnson & Phillips' cable gear.



Arthur Hartley: 'The finished cable, full of water, weighted 63 tons per nautical mile and was made in continuous lengths of 35 nautical miles.'

Johnson & Phillips' works are now no more. The pipe-handling equipment was manufactured at their Victoria Works situated at the southern end of Dupree Road in Woolwich. *Left:* **This is the old bricked up entrance where HRH The Duchess of Kent was greeted on March 19, 1945** *(right)* **by the Chairman and Managing Director Mr G. Leslie Wates, the Deputy MD and General Manager Mr W. Glass and Mr F. O. Townsend of the Factory Inspectorate.**

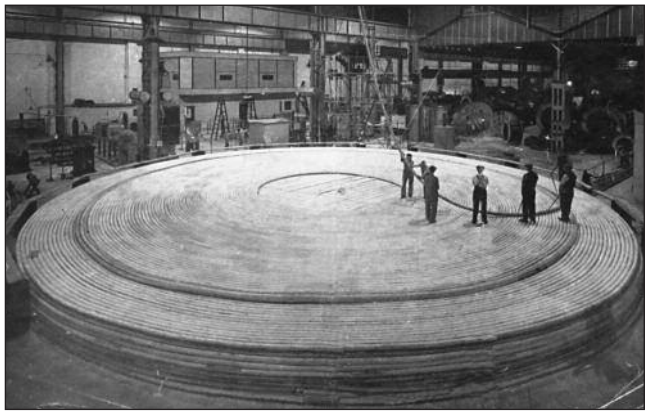


The three main cable companies used for the manufacture of Hais were all situated on the River Thames. The Siemens' factory on Harden's Manorway at Charlton still stands although the storage building *(above left)* **is now the print works of Campaign Posters Ltd** *(above right).*

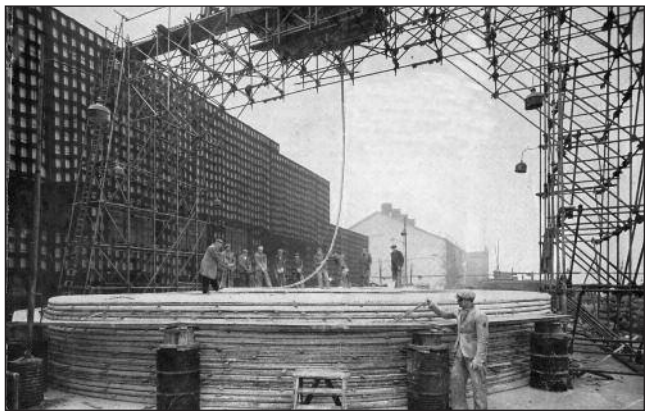
After successful initial tests carried out with a 2-inch diameter hollow cable quickly produced by Siemens, a sizeable length of Hais was experimented with as a loop in Chatham Dockyard. This revealed that under high pressure the lead tubing was pushed through the protective outer steel taping and that some of the joints fractured. The cable manufacturing firm of W. T. Henley's Telegraph Works Co. Ltd was brought in which for some time had been working on a 'straight-through' method of extruding lead pipe free of longitudinal seams. A length was laid in deep water in the Clyde with the Post Office undertaking the work, its experience and assistance proving invaluable throughout the project. Then in December came full-scale trials in the Bristol Channel.

For these, a 30-mile experimental length of 2-inch Hais cable was laid by a former cargo vessel, the SS *London,* which had been fitted out with Post Office machinery and gear, and (with a crew of mostly cable hands and merchant seamen) renamed HMS *Holdfast* by the Navy. On December 29, 1942, the ship made a successful run from Swansea, on the Welsh side of the Bristol Channel, and dropped and buoyed the line off Watermouth, on the north Devon coast, near Ilfracombe. With the help of the system's designers, the RASC brought the line ashore, and training continued in the intricacies of high-pressure pumping and storage. After the line had been brought into operation in April 1943, little did those people of Devon and the West Country possessing petrol coupons realise that their fuel had been pumped under the Bristol Channel from Wales! The line achieved an average of 125 tons (38,000 gallons) of petrol a day, at a pressure of 750lb per square inch, and led to a decision to experiment with 3-inch cable of greater capacity.

The river scene on the day the Chiefs-of-Staff came to inspect progress on Pluto — now transformed with the Thames Barrier and the skyscrapers of Canary Wharf. (MD)

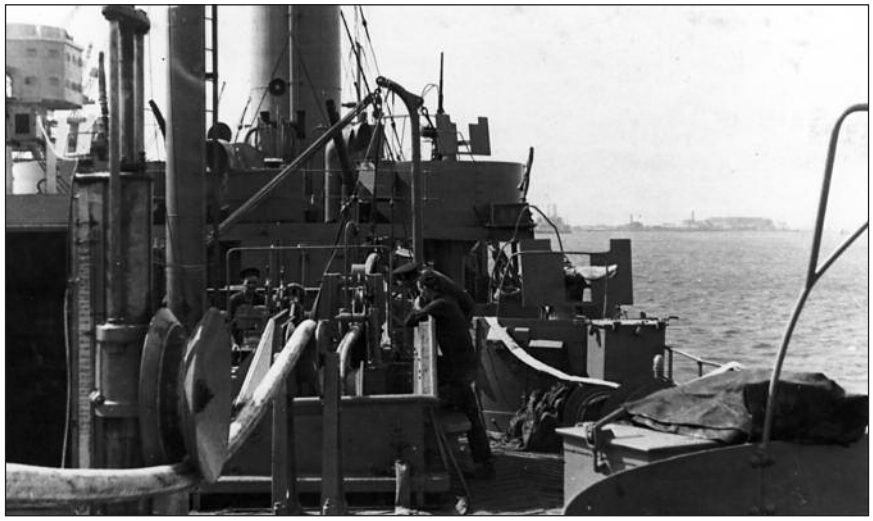


On the other hand, Henleys' factory in Crete Hall Road at Gravesend is still very much into the cable-making business, albeit under a new name: AEI Cables, a subsidiary of TT Electronics. *Above:* **The same manufacturing hall — then and now.**



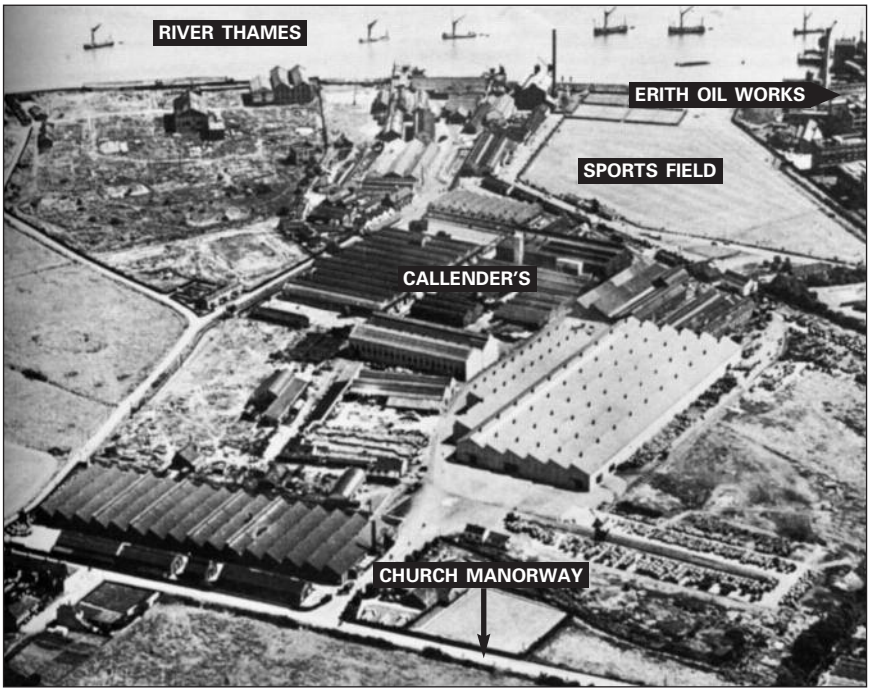
Left: **The Hais cable was coiled on the river front outside the factory where a massive gantry had been erected to carry the heavy pipe to the jetty.** *Right:* **A modern covered cableway does the same job today . . .**

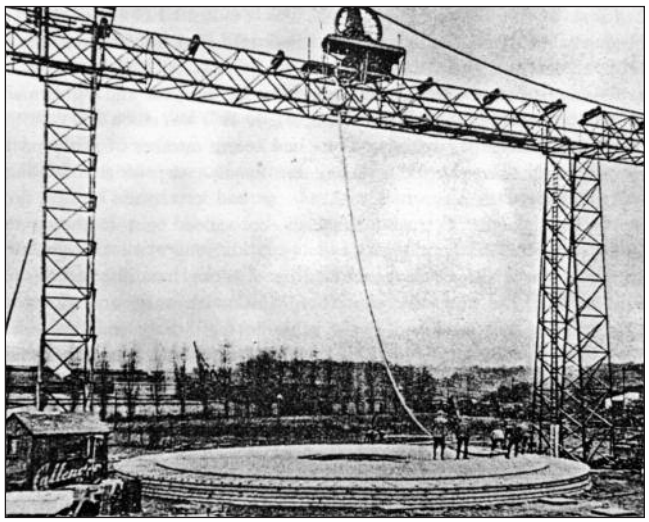
. . . but the original old jetty *(above)* **still survives!** *Right:* **What is interesting about this shot of the cable entering the hold is that one of the Army coastal forts can be seen on the extreme left awaiting its turn to be towed out and sunk as a forward anti-aircraft battery at the mouth of the Thames (see *After the Battle* No. 4). Arthur Hartley wrote that of the 570 nautical miles of lead sheath used in the construction of the Hais cable for Pluto, 463 miles were made on the straight-through presses at Henleys and the Telegraph Construction & Maintenance Company and 87 miles on the Pirelli continuous extrusion machine by Pirelli General Cable Works Ltd, Johnson & Phillips, the Standard Telephones & Cables Ltd. and the Edison Swan Electric Co. Ltd. the balance being supplied by W. T. Glover & Co. Ltd on their 'Farmer' press. The lead sheath was manufactured in 700-yard lengths which were joined by lead burning.**

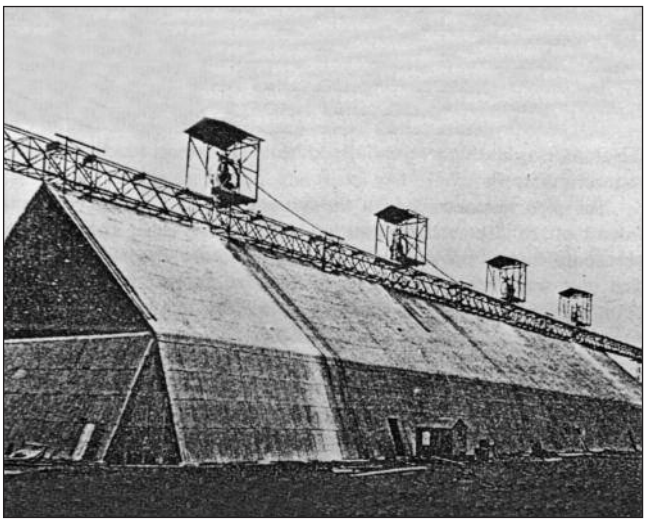


Callender's Cable & Construction Company in Church Manorway at Erith were advised in May 1943 that because Siemens and Henleys were heavily engaged with producing the 2-inch pipe (at a rate of ten miles per week), Callender's were needed to produce a nautical mile of the 3-inch version for experimental purposes. Thereafter the company were asked to start armouring lengths of the 2-inch pipe which had been made by Henleys. These were supplied in continuous lengths of 30 miles which had to be loaded into the vessel moored at the nearby jetty at the Erith Oil Works. This entailed building a gantry across the sports field which was constructed using Callender-Hamilton bridge techniques.

As the extrusion of the lead pipe had to be carried out without the normal supporting core of conducting cable and its insulation, the pipe had to be pressurised to avoid collapse. Also the steel armouring tape wound around the lead sheath had to be precisely applied for a single leak would put the entire pipeline out of commission. Thirty miles of 2-inch cable weighed 1,200 tons and 3-inch 1,680 tons, necessitating a winch with a power of about three tons to haul the pipe along the gantry. Callender's, with their four armouring machines were vital to the manufacturing process and, apart from making 128 nautical miles themselves, they armoured a further 129 miles of lead pipe produced elsewhere.



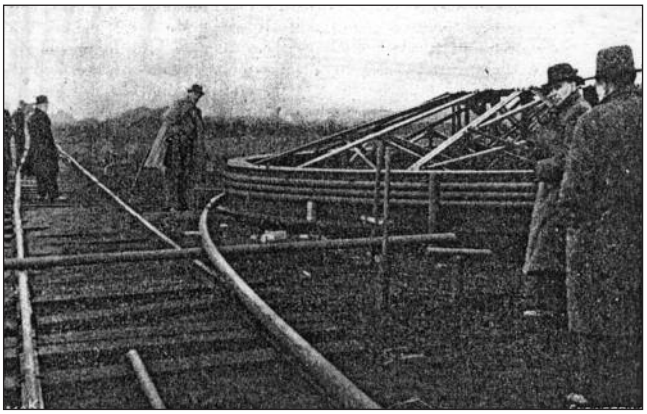




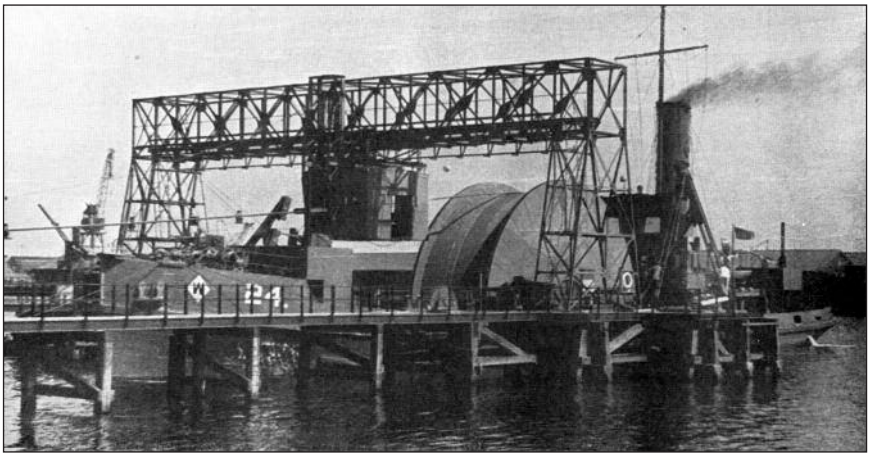
'At the commencement of the production of 3-inch Hais cable', explained Arthur Hartley, 'it became necessary to obtain much greater manufacturing capacity and therefore additional machines were brought into operation at Callender's Cable & Construction Co. Ltd, Glovers, and Pirellis. In the case of Callender's, four machines were finally brought into production, and an overhead gantry 45 feet high by 1,600 feet long with supporting towers every 70 feet *(above left)* **was constructed to carry cable from their armouring shop to an adjacent deepwater jetty. Eight 60-foot diameter coiling sites were situated between the supporting towers to facilitate continuous manufacture and loading; and these sites were covered by a continuous, light-framed, steel building which had to be erected due to black-out regulations** *(above right)*. **A similar arrangement was made for two armouring machines at Glover's and for storage and loading at the Manchester Ship Canal. In February 1944, I visited the United States to arrange the manufacture of cable at four works there, to meet the increased requirements. A total of 710 nautical miles of Hais cable was produced for Operation "Pluto", of which 140 miles came from the United States.'**

After the war, Callender's merged with British Insulated Cables (which had been involved with the other Pluto pipeline — the Hamel — see opposite) to become BICC. That company was taken over in turn by another Pluto company, Pirelli Cables in August 2000. The works still manufactures cables in a modern building on the same site. In this picture we are looking back from the river towards the factory across the old sports field crossed by the wartime gantry. Today cables are fed into cable ships along the ground-level conveyor running alongside the boundary fence with the oil works on the left.

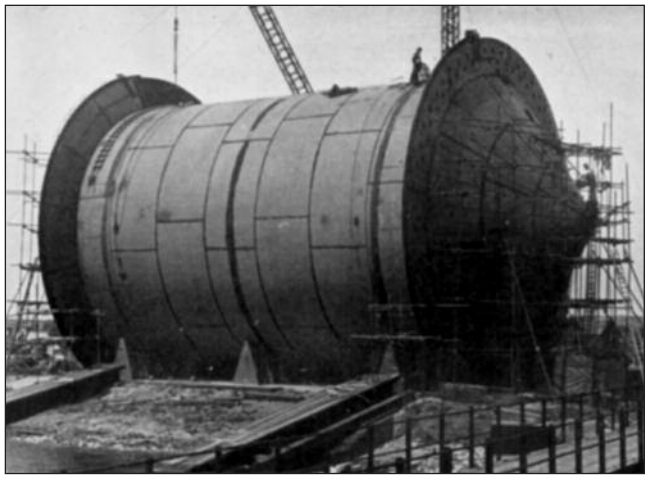
Arthur Hartley explains how the alternative type of pipeline came about. 'The second novel proposal came at the end of April 1942 from Mr B. J. Ellis of the Burmah Oil Company and Mr H. A. Hammick of the Iraq Petroleum Company. They were already dealing with the Hais cable and, when they saw how flexible it was in a long length, although extremely stiff in a short length, they suggested that steel pipe, which they had also seen to be very flexible, when handled in long lengths in the oil fields, might also be used for making long lengths of line required in one piece. With the assistance of Stewarts & Lloyds, J. & E. Hall, of Dartford, and A. I. Welding Machines Ltd. they quickly proved that 3-inch steel pipe, code-named "Hamel" after the name of its two inventors, could be bent round a wheel 30 feet in diameter, could be pulled off again relatively straight without kinking, and could be flash-welded to provide any required length. However, they realised that it could not be handled like cable in horizontal stationary coils in a cable ship because this involves a complete twist in each turn while coiling down, and its removal while uncoiling for laying.'

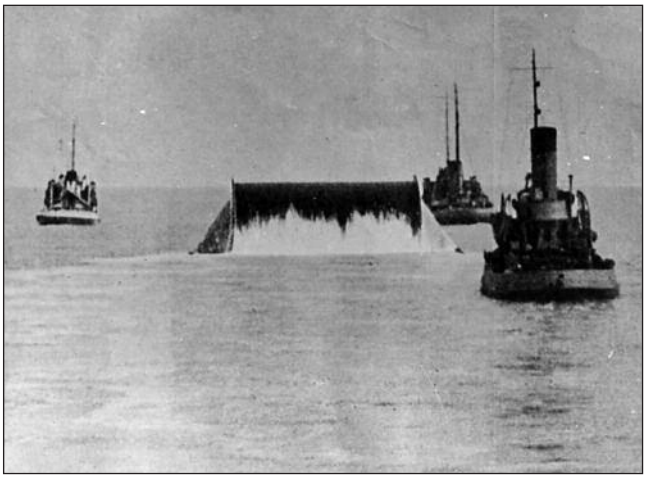


The second method employed for Pluto was for a welded steel pipe, called 'Hamel' after its two inventors, Mr H. A. Hammick, chief engineer of the Iraq Petroleum Company, and Mr B. J. Ellis, Chief Oilfields Engineer of Burmah Oil, who had now been seconded to the Petroleum Division. As the Hamel pipe was too stiff to coil in the hold of a ship, the idea was conceived of winding it round a floating steel drum and unwinding it at sea as if from a gigantic cotton reel. Tests at the National Physical Laboratory demonstrated that 3-inch steel pipe could be bent and coiled around a diameter of 40 feet, and model drums were used to act as bobbins in the trials that were undertaken. Sea trials followed, using a converted hopper barge commissioned by the Navy as HMS *Persephone*. This vessel was fitted with an enormous drum which rotated in trunnions on her deck and paid out steel pipe through her bottom. Giant floating drums 90 feet long and more than 50 feet in diameter — cone-ended, hence their being called 'Conundrums' — were constructed for towing across the English Channel.

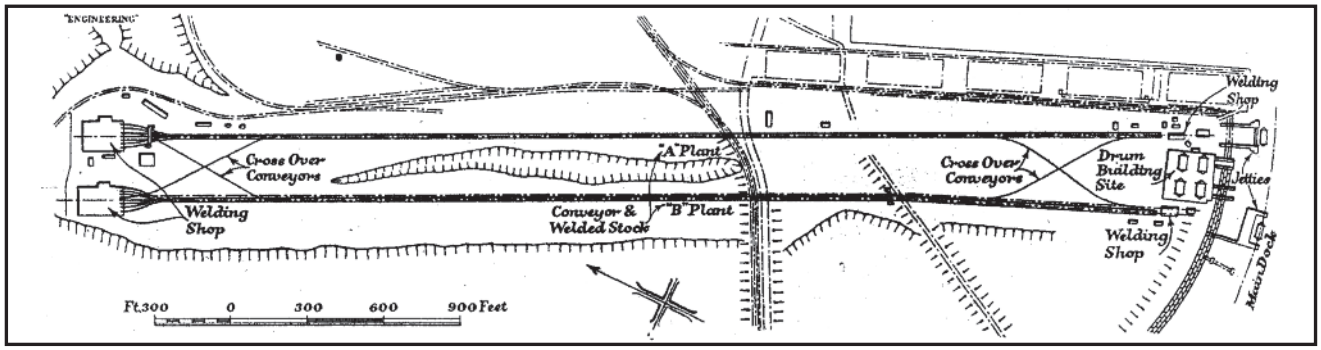


'Mr Ellis therefore suggested, the use of a large wheel mounted on trunnions on the deck of a hopper barge with its lower portion protruding into the sea through the hopper doors, and a vessel was so converted and named HMS *Persephone*, seen here taking on Hamel pipe from the gantry at Tilbury.'

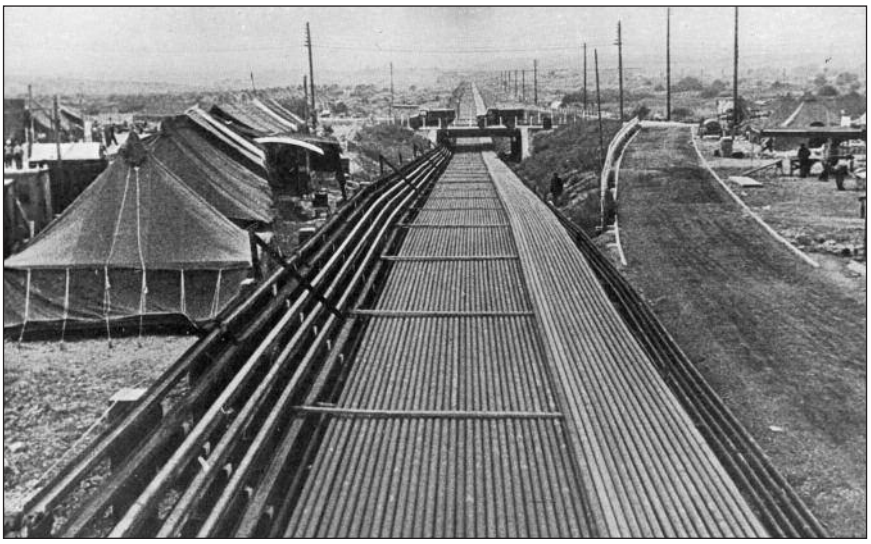




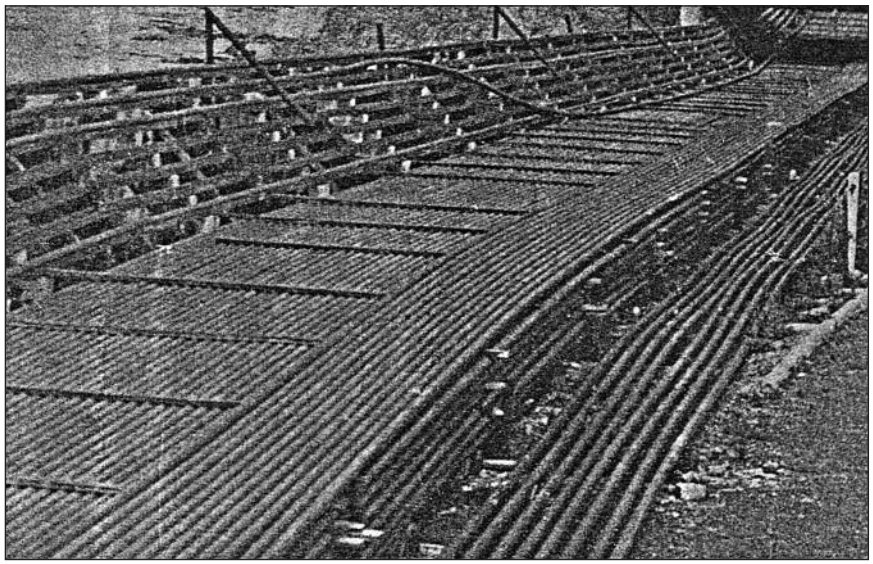
'Later, a floating drum like a gigantic cotton bobbin, capable of carrying any quantity of pipe likely to be required, was proposed', recounts Arthur Hartley. 'Model tests of the floating drum — HMS *Conundrum* or "Conun", as it came to be called — were made at the National Physical Laboratory in their Froude tank and confirmed that such a vessel could be towed at sufficient speed without yawing. Preliminary work had thus proved that the pipe could be bent and pulled off straight, that it could be welded with absolute reliability, and that it could be carried and laid by either the wheel and barge or the Conuns, but there was no previous experience as to how bare steel pipe would lie and behave on the bottom of the sea. It was felt, however, that it would have at least a six-weeks' life, and on this basis (bearing in mind that it was by no means certain there would be sufficient supplies of lead available to produce all the Hais cable required), it was decided to proceed with all speed with a factory at Tilbury to weld, store, and wind Hamel pipe and construct six Conuns. Stewarts & Lloyds Ltd undertook, in addition to the steel pipe, to act as agents of the Petroleum Division for the design, construction, and subsequently the operation, of the Tilbury factory. Pending completion of the factory, some miles of 3-inch steel pipe were hand-welded at Portsmouth Dockyard and wound on *Persephone's* wheel for preliminary trials which were, to the admitted astonishment of most of the spectators, entirely successful. This was early in April 1943, so both the Hais cable and Hamel pipe had been brought successfully through their full-scale trials, and production on a considerable scale had been organised by the Petroleum Division and Chief of Combined Operations before they handed on responsibility for the operational stage respectively to the Petroleum Warfare Department under its Director-General, Major-General Sir Donald Banks, and to Force 'Pluto' specially organised by the Admiralty under the command of Captain J. F. Hutchings. Thus, after visiting Watermouth on April 24, 1943, and seeing the Hais cable in actual operation, the Quartermaster-General was able, on April 29, to visit the Hamel factory at Tilbury, to see Hais cable in production at both Henleys at Gravesend and at Siemens at Woolwich, where he also saw HMS *Holdfast* loading cable. He decided that further lengths should be ordered at once.'



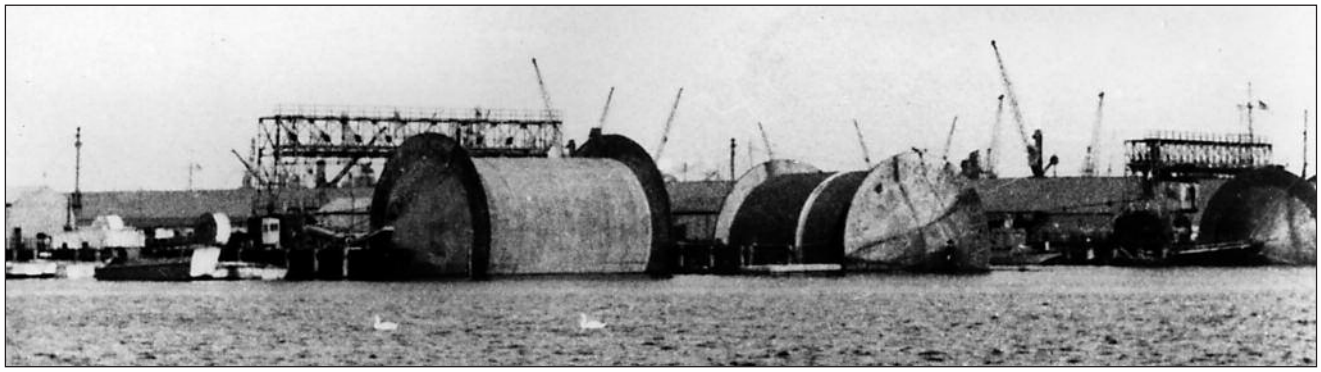
By June 1943, a factory operated by Stewarts & Lloyds had been built beside the Thames at Tilbury to receive the first lengths of pipe which arrived by rail from Corby in the Midlands. The Tilbury operation welded the pipe into sections of 4,000 feet which were progressively pushed forward down long roller ways stretching to the water's edge. For storage they were hauled off alongside by one man pulling the end of a section off the roller way — the movement communicating itself along the entire pipe. Suspended on a gantry above a slipway, the Conundrum was rotated to pull sections of pipe on to it from storage, each section being welded to the next to form a continuous line.



Arthur Hartley: 'Two factories with storage sites were erected at Tilbury, each having seven lines of machines consisting of a flash welding machine, a Taylors pipe-cutter, and a traversing machine. The standard 40-foot lengths of pipe were welded one by one to form lengths of 4,000 feet *(right)*.'



One of the most amazing sights to be seen at Tilbury during the Pluto operation occured when each length of pipe was completed. Each length comprised 100 pieces of 40-foot pipe welded together to form one 4,000-foot long. As each piece of pipe was added, the pipe moved forward towards the river gripped by spring-loaded pads which pushed it along a conveyor consisting of rolled-steel channels. Storage space was provided below the conveyors and, when each length was completed, a few yards were lifted off at one end. Due to its weight and elasticity, the rest of the pipe then threw itself sideways at around 120 mph as can be seen in the photo *(left)*. **A welding machine then joined the 4,000-foot lengths as it was wound on the Conun drums. Arthur Hartley explained that 'low-carbon mild steel was used to facilitate the welding, and the pipe was made 3½ inches in external diameter, with a wall thickness of 0.212 inch and a weight of 20.21 tons per nautical mile.'**

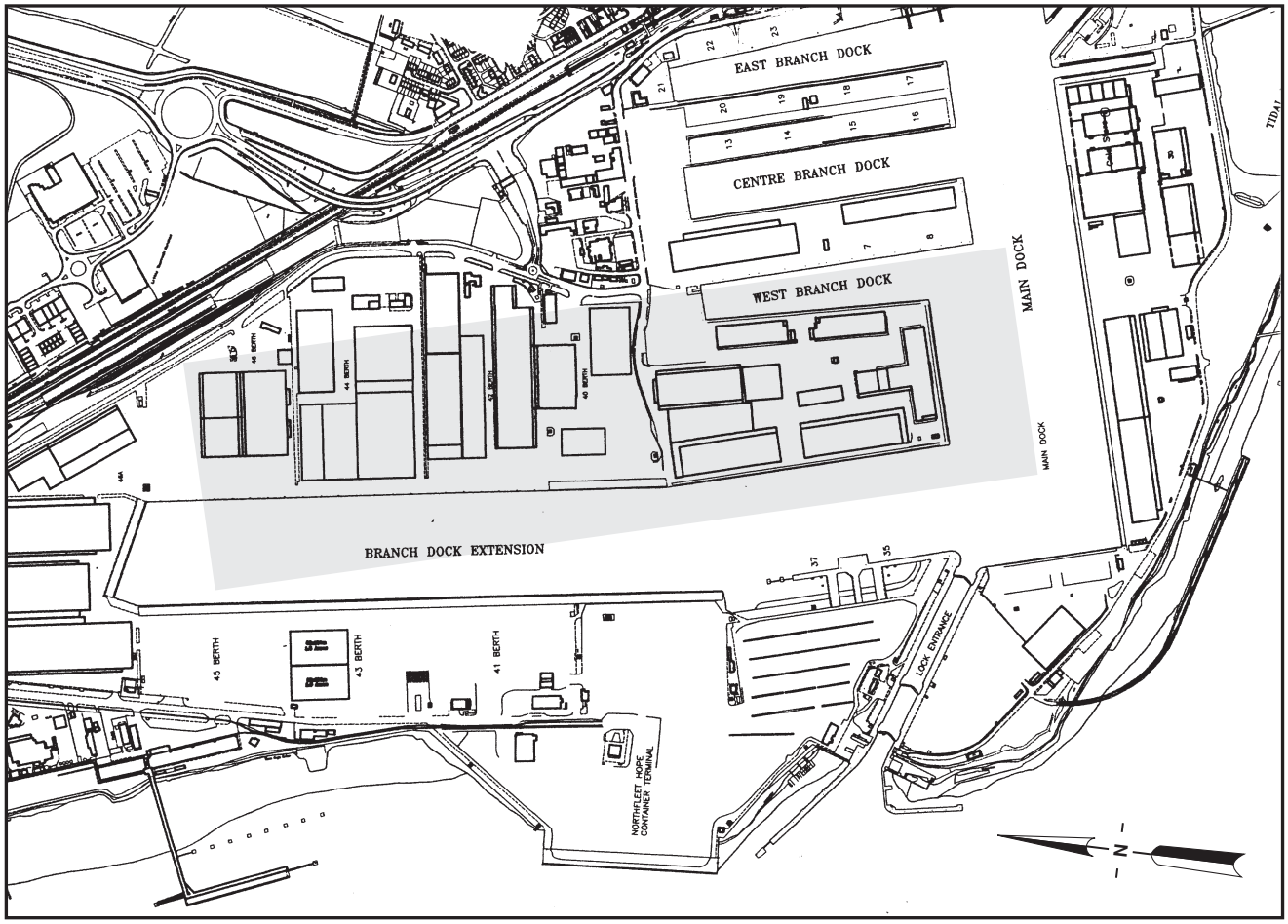


Arthur Hartley explained that 'hinged arms were provided at the end of the jetty to hold the Conun in position by its trunnions, and means were provided to ballast it with water when light to minimise wind effect.' (MD)

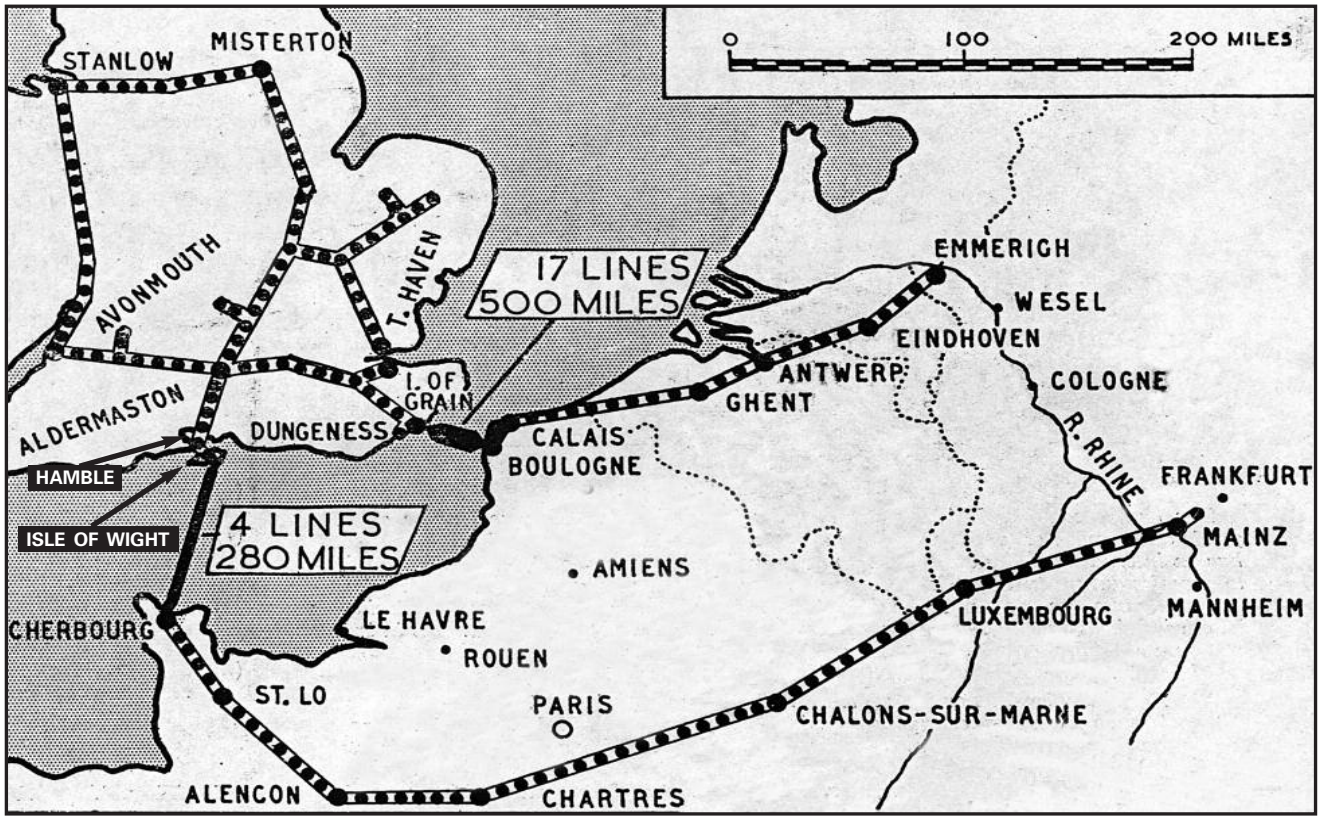
Tilbury docks pictured by the RAF in May 1946. We have arrowed the two Hamel factories.

Also in June 1943, the British Chiefs-of-Staff directed that the Pluto project should be a 'matter for immediate execution'. In April, the Petroleum Division's co-ordinating function — the responsibility for design, development and administrative work in conjunction with the services — had passed to the Petroleum Warfare Department. The change had been made by Mr Lloyd as the division was experiencing problems in its dealings with the services, and it was felt that the more services-oriented Petroleum Warfare Department would be better suited to the role. This department had been created in July 1940 under the aegis of the then Petroleum Department for the development of novel weapons and devices making use of petrol and oil, and was headed by the officer whom Lloyd had poached from the Army to 'burn the invader back into the sea', General Sir Donald Banks. Flame-throwing tanks and carriers ('Crocodiles' and 'Wasps') had since been among the ideas developed, and 'Fido' — Fog Investigation Dispersal Operation, for landing aircraft safely — was being experimented with under the direction of the department's technical director, the protagonist of Hais, Arthur Hartley, on loan from Anglo-Iranian. Mr Hammick, co-developer of Hamel also joined the department.

On the naval side, the project's fortunes were in the hands of Captain J. F. Hutchings. In the broad division of functions, the Navy was responsible for operations from high to low water marks, the Army for running the pipelines on the European mainland and the petroleum authorities for the pumping stations on British shores, to which the RASC were attached.



The post-war expansion of Tilbury docks and the construction of the new Branch Dock Extension in 1963 has totally obliterated the Pluto workings. The area depicted on the plan at the top of the opposite page covers the shaded area on the present-day plan



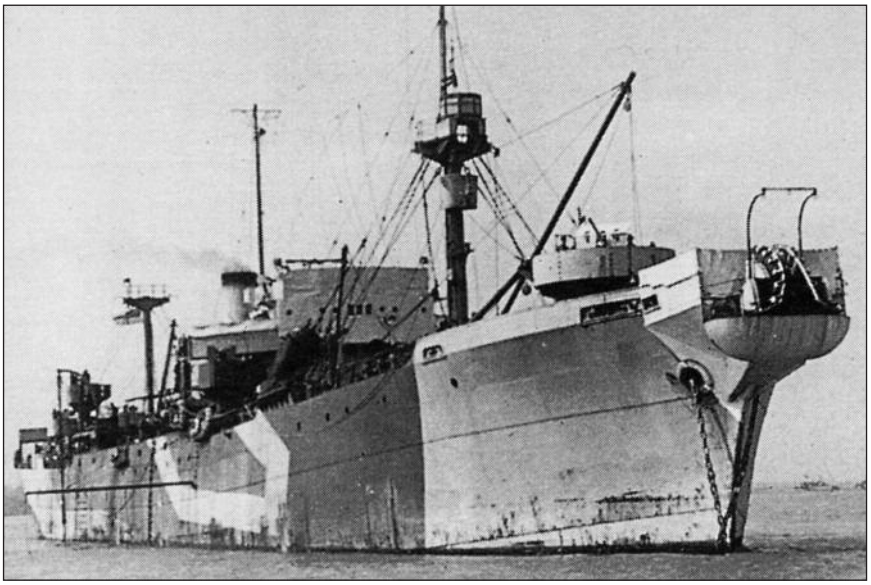
In June 1945, the *Petroleum Times* was permitted to publish for the first time a general outline plan showing the military supply pipelines, both in the UK and across the Continent. Nevertheless it was heavily censored as the spur lines for conveying aviation fuel direct to specific bases — as happens today — have been excluded.

Oil imported to Britain was mainly distributed by the railways. With the Channel closed to ocean tankers after France fell, coastal movements were also made by small vessels. Road transport carried supplies on shorter haul journeys, primarily from distribution centres to where they were needed. At the end of 1940, there were 7,000 railway tank wagons, which by mid-1944 had risen to 9,600, plus 500 from the United States used during the summer and autumn although destined for the Continent. When the war began, the petroleum authorities could call on 4,900 vehicles, a number which was to rise by only 500 by May 1944. Considerable increases were to be achieved in the railways' delivery performance; the Channel was reopened in September 1944; road tankers were to run a total of 103 million miles in 1944 compared with 64 million in 1940 — but the major scope for the expansion of long distance oil distribution was seen to lie in pipelines.

The first new pipeline of the war had been laid from the Gloucestershire port and oil storage area of Avonmouth to Walton-on-Thames in 1941 to help supply the London region from the west coast. As an important supply point for an invasion, Southampton was linked to it by a branch line from Aldermaston which was completed in June 1942. This was built in response to the question of how oil was to reach the south coast as the planners foresaw Southampton being fully occupied with outward shipping movements during a cross-Channel operation and likely also to be under heavy air attack, while the surrounding roads and railways would be loaded with other military traffic. The branch was planned to have an ultimate capacity of 120,000 tons a month, pumped from Avonmouth or, if need be, through the north-south line all the way from the Merseyside storage area of Stanlow in Cheshire. The largest scheme was for supplying the 'bomber area' of eastern England — the creation of a completely new circuit comprising new lines from Stanlow to Misterton (near Doncaster) and Sandy in Bedfordshire, connecting with an extension from Aldermaston of a second line laid alongside the first from Avonmouth. The second line improved the facilities for supplying Southampton without disrupting supplies to London; its size catered for both the 80,000 tons a month required in the 'bomber area' and the 120,000 tons a month needed to feed the branch to Southampton. By the autumn of 1943, a 70-mile link had been laid between Walton-on-Thames and the site chosen for a Pluto pumping station on the Kent coast at Dungeness. Later, two small spurs ran from this pipeline to an air force depot at Wye and a small Navy tankage at Rye. Another line was laid between Walton-on-Thames and the big oil installation on the Isle of Grain. For Pluto, this meant that the project was connected to a third main importing centre apart from Avonmouth and Stanlow.

The pipelines to Cherbourg (code-named 'Bambi') had to draw their fuel via the Isle of Wight. *Left:* Adrian Searle pictured the remains of the 12 lines coming ashore in Thorness Bay from the mainland. *Right:* An old valve discovered in the BP oil terminal at Hamble-le-Rice which once fed fuel across the Solent was refurbished for the 50th anniversary of the laying of Pluto.

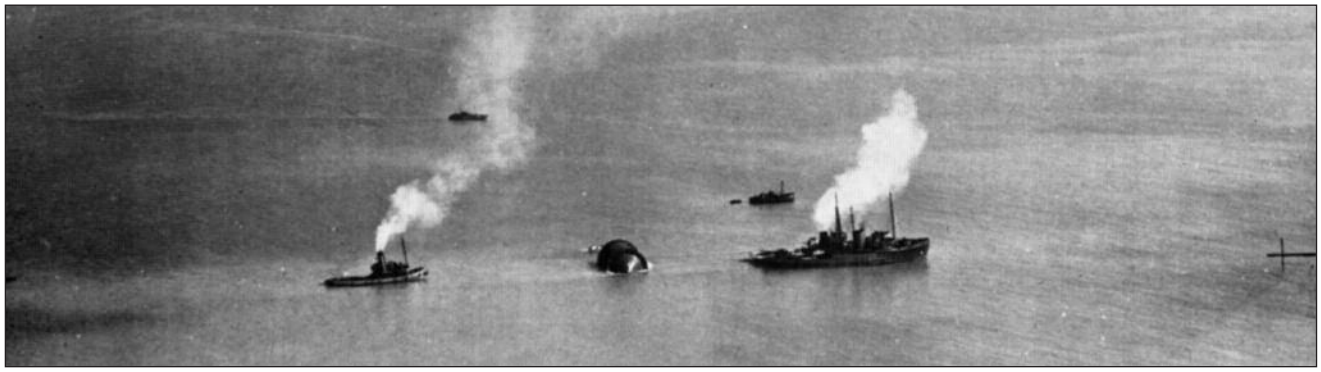
Arthur Hartley: 'During June and July, recommendations were made by the Quartermaster-General's Petroleum Committee, and confirmed by the Chiefs-of-Staff Committee, who awarded a high priority, that the English pipeline system should be extended to Dungeness and to the Isle of Wight and that pumping stations of 3,500 and 3,000 tons a day capacity, respectively, should be erected at these places. The Isle of Wight to Cherbourg crossing, then considered for the first time, involved a sea crossing of about 70 nautical miles instead of the 20 or so originally visualised, and made necessary the provision of larger cable ships and the use of the Conun loaded down till the axles were awash. Following a successful lay with 3-inch Hais cable three more ships were obtained to be converted and fitted with cable gear by the Director of Naval Construction. HMS *Algerian* was to carry 30 miles of 3-inch cable, and the other two, HMS *Latimer (right)*, and HMS *Sancroft,* were to carry 100 miles of 3-inch cable weighing about 6,400 tons.'



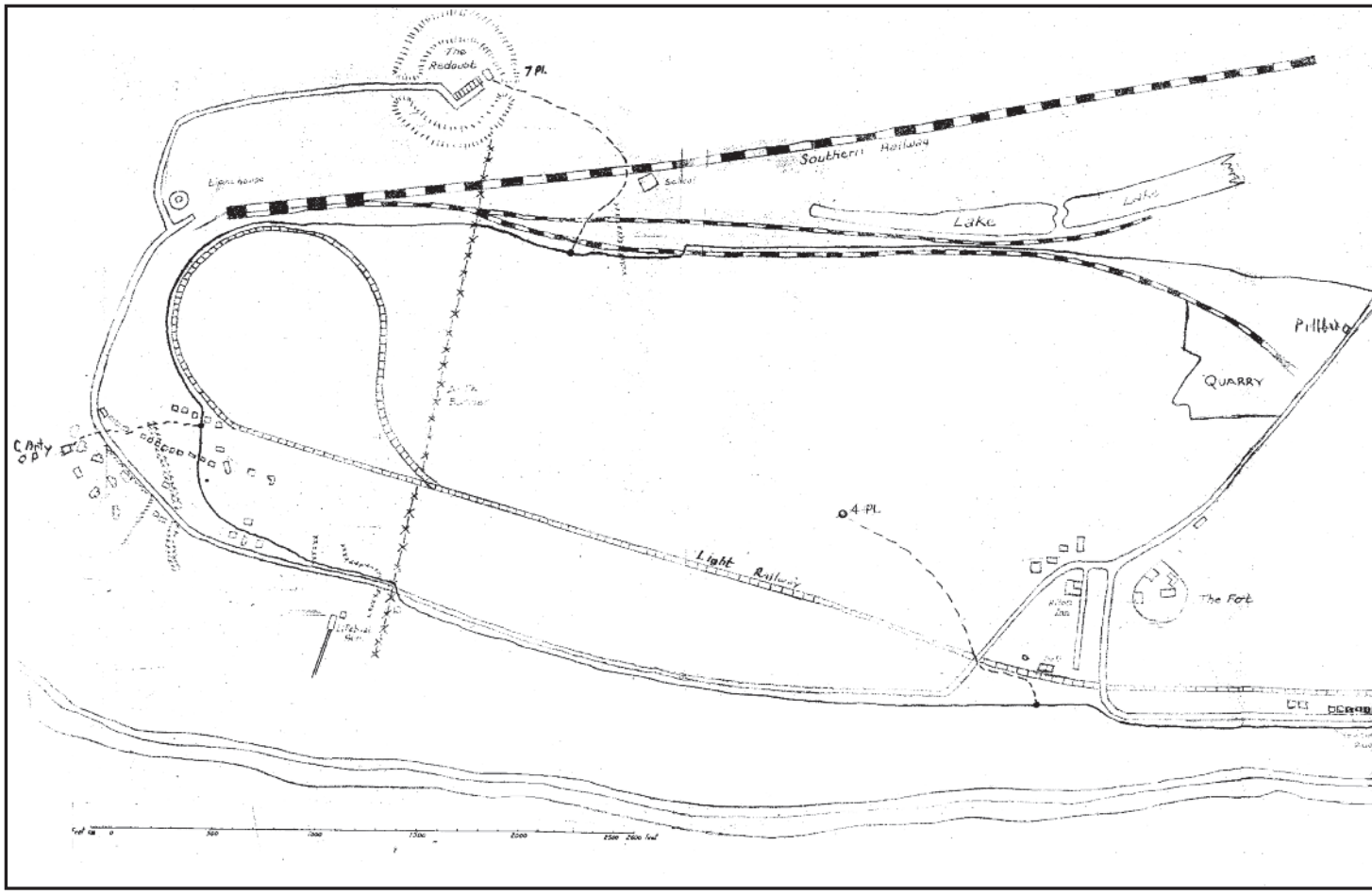
With Normandy chosen for the invasion rather than northern France, construction of the pumping station at Dungeness took second place to the two sites selected on the Isle of Wight. These were at Sandown and Shanklin about three miles apart and gravity-fed from a 620,000 gallon tank (code-named 'Toto') erected in a small wood on a hill at Shanklin. An old coastal fort at Sandown dating from Napoleonic times, already being dismantled when it was made use of as a defensive position in 1940, provided excellent cover and accommodation for the installation of pumping machinery. At Shanklin amidst a row of bomb-damaged buildings beneath the town's cliffs, a new 'wrecked' elevation was added to conceal the installations.

Hais and Hamel lines were laid across the Solent, connecting up with the storage tanks at Fawley, at the end of the Aldermaston to Southampton pipeline — all providing much-needed experience for the laying parties — and lines were laid in Sandown Bay to connect up the two pumping stations laterally. Collectively, these pumping stations were code-named 'Bambi'. The distance from Sandown Bay to Bambi's destination, the Cherbourg peninsula, was about 70 nautical miles.

'The Isle of Wight pumping installation at Sandown consisted of 18 pumps, and that at Shanklin of ten, these stations being cross-connected by two Hamel line loops laid out to sea and in again. Thus, if either of the installations had been "blitzed", the other could have taken over. The Petroleum Board constructed the land lines and a large number of Hais and Hamel lines were laid across the Solent, both to provide the link across to the Isle of Wight, and also, at the same time to train its large new force and develop and try out its ships and gear.' *Right:* **On Shanklin Chine a remnant of Pluto was left beside the path. A nearby notice tells the story: 'P.L.U.T.O. (Pipe Line Under The Ocean), one of the engineering marvels of the last World War, by which petrol was pumped by pipeline direct to the Allied Invasion Forces in Normandy, passed through this Chine on the end of its long journey across the country. From the pumping station on the Esplanade it commenced its last journey across the bed of the Channel.'**



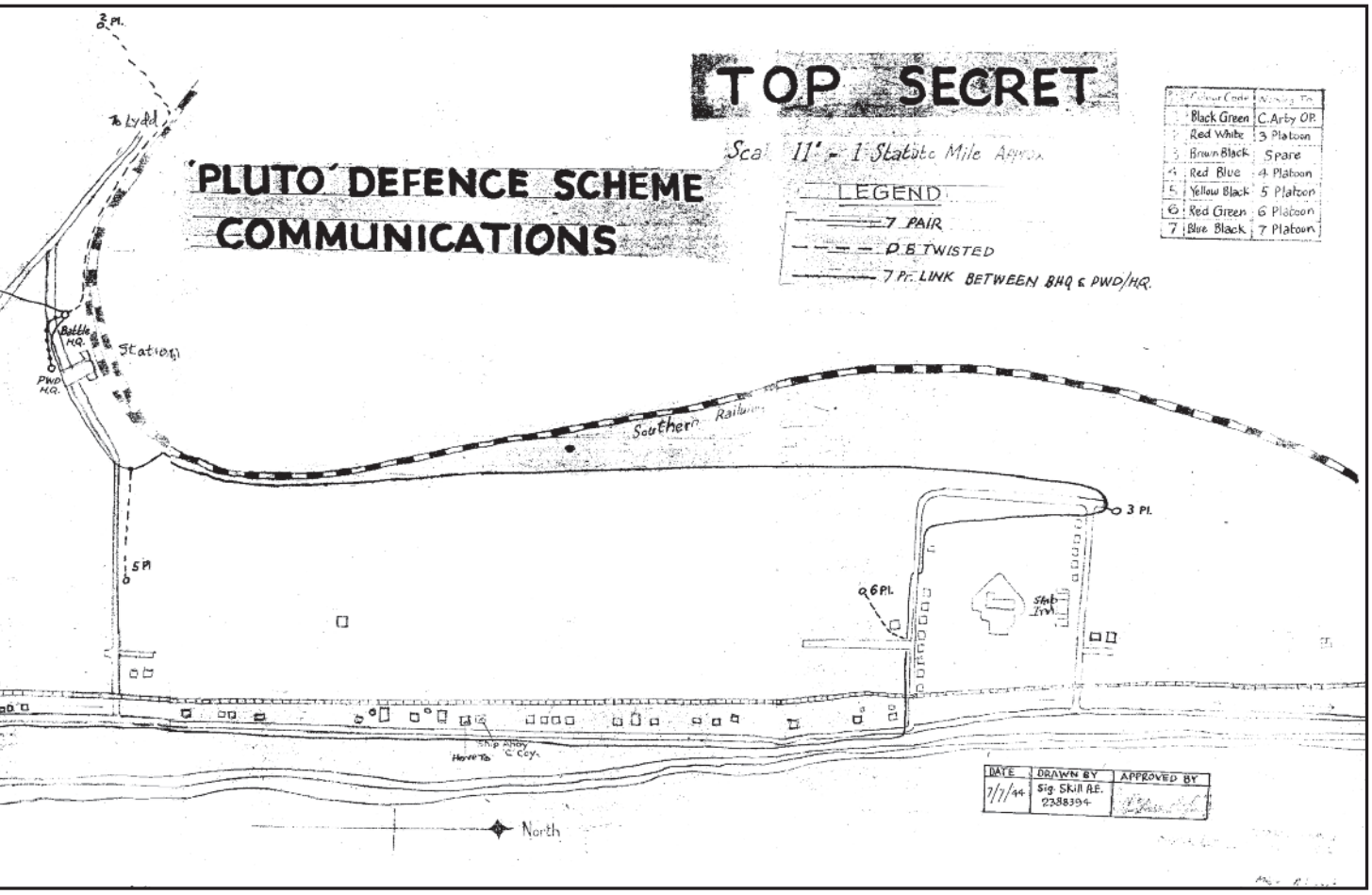
'Full-scale trials were made with the Conun in the Thames in February 1944 and in Bournemouth Bay in April', explains Arthur Hartley, 'during which the technique for towing at speeds up to seven knots was developed. It was the decision to lay Pluto lines to Cherbourg which had made necessary much larger supplies of Hais cable and Hamel pipe; and, in addition to increasing the British manufacture of Hais cable as much as possible, and starting production in the USA, the decision was taken to duplicate the Tilbury facilities for welding and winding Hamel pipe.'



The secondary station at Dungeness, 'Dumbo', lay on the shingle of the flat bleak Kent promontory, back from the shore where a ribbon of little holiday villas faced the sea. Into a number of these were crammed pumping machinery and controls. All telltale signs were camouflaged; shingle was heaped over the end of the inland pipeline; and before it reached the area, it was made to look from the air as if it led to the beaches at Hythe and Folkestone and might have something to do with preparations for an assault across the Straits of Dover.

The aim was for Pluto to provide a cross-Channel capacity of 4,000 to 5,000 tons a day — 40 to 50 per cent of the expected requirements of all oil products. Bambi would consist

The installations at Dungeness were camouflaged beneath the shingle which covers the bleak and windswept promontory.



'At Dungeness', wrote Arthur Hartley, '30 reciprocating and four centrifugal pumps, designed for 1,500lb per square inch pressure, were installed at three well-dispersed sites along the coast and were fed from the land-line system. The reciprocating pumps were manufactured by Frank Pearn Ltd. and delivered approximately 40 Imperial gallons of fuel per minute, when running at a speed of 45 rpm. They were driven by 60 hp Caterpillar engines. The centrifugal pumps were manufactured by Mather & Platt Ltd and delivered 214 Imperial gallons per minute, and were driven by 500 hp motors. The Anglo-Iranian undertook the supervision of the erection of the pumping terminals and tankage by civilian contractors and RE, RASC and Pioneers.'

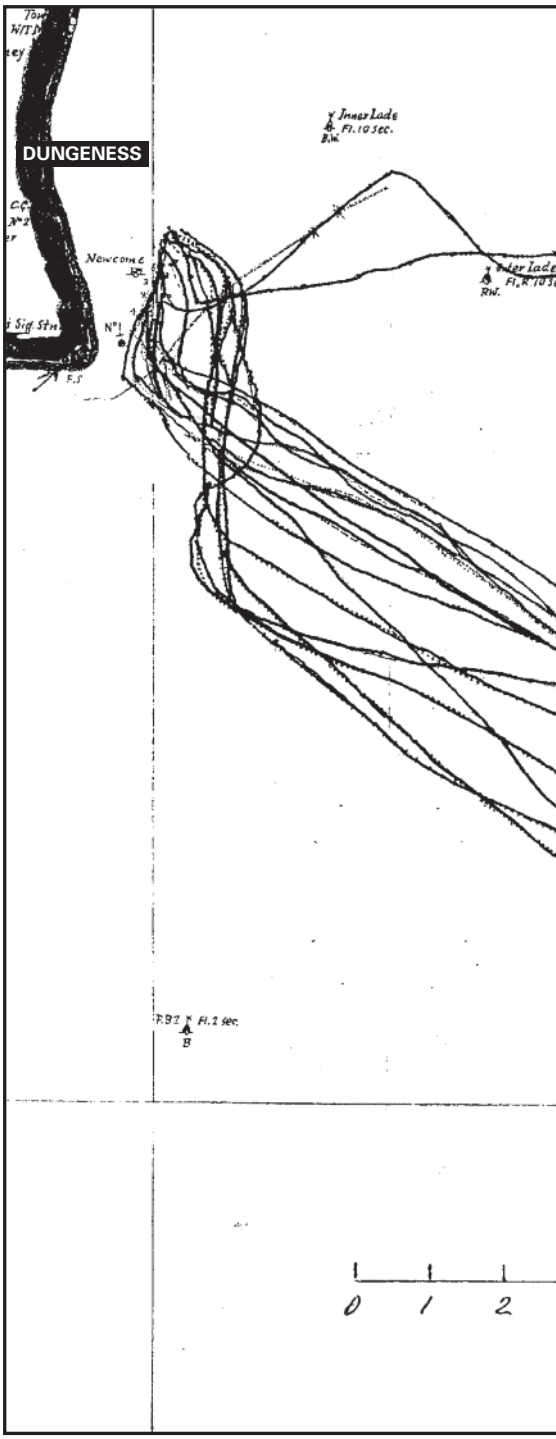
Save for the erection of the nuclear power station in the far distance, time has stood still in this corner of Kent.

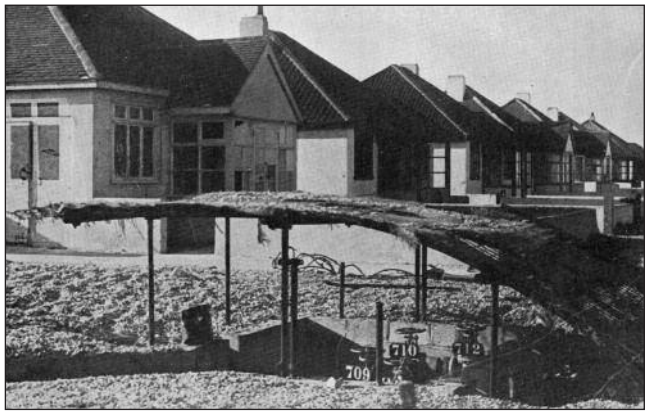
Left: **The main pumping control for the British end of 'Dumbo' — the code-name for the Dungeness operation — was located in 'Hove to' on Coast Drive at Lydd-on-Sea (see plan pages 20-21).**
Right: **The same house has now been renamed Fort George.**

of six 3-inch lines of Hamel pipe and four 3-inch lines of Hais cable, and was intended to have a throughput capacity of about 3,500 tons a day. Dumbo, running from Dungeness to northern France, would make use of the pipe and cable left over plus all the 2-inch cable that had been manufactured before the change to 3-inch and that was of too small a capacity to make it worth laying all the way across to Normandy. Throughput capacity was envisaged as about 3,000 tons a day. The first of the Bambi pipelines was intended to be laid 18 days after D-Day (on to the open shore if necessary) and the others by D+75. The Dumbo system, with its far shorter run, obviously could not come into operation until a later stage.

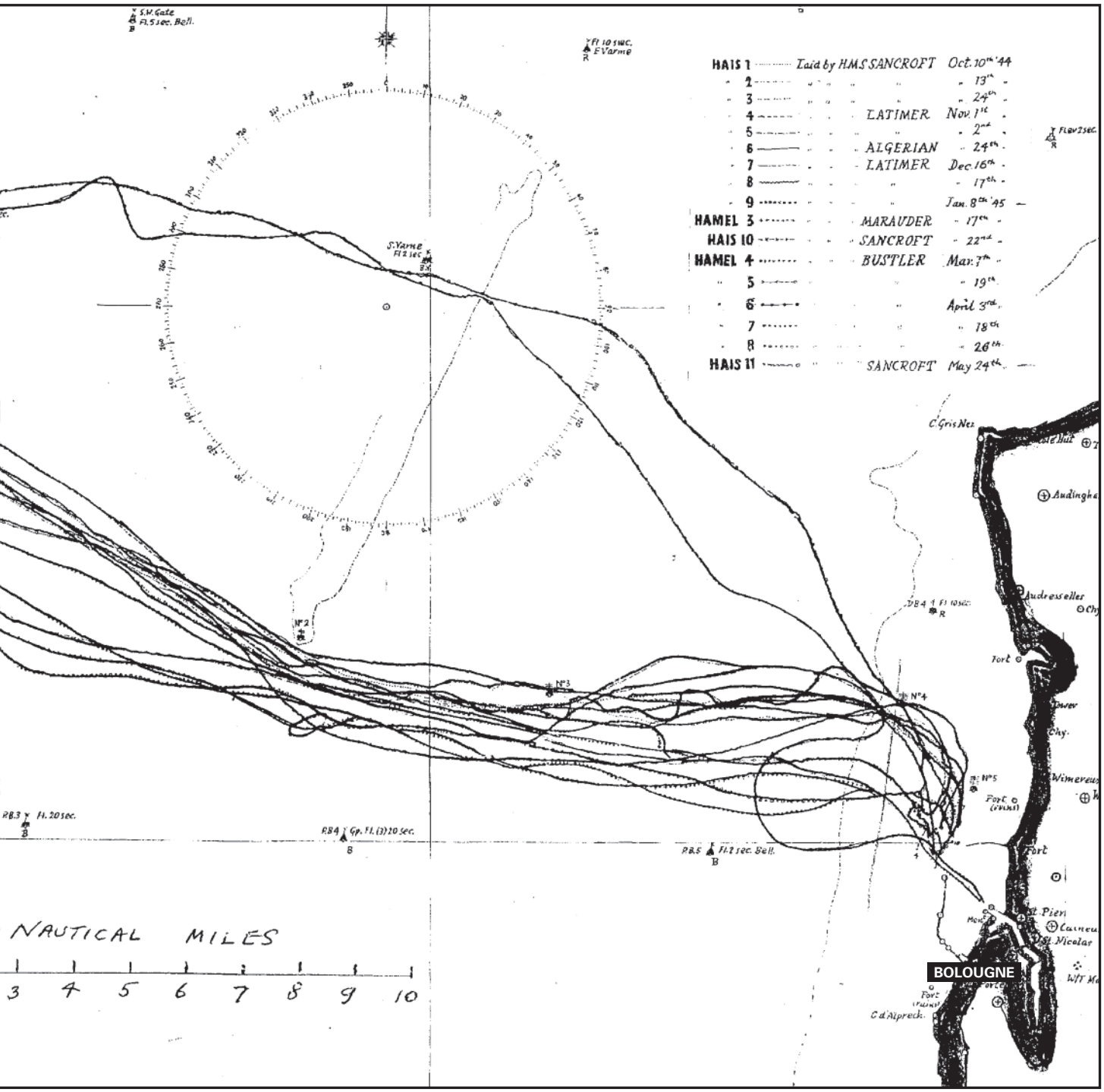
The control team at Dungeness. L to R: Lieutenant H. Begg, Lieutenant E. Moody, Lieutenant D. Stirling, Captain E. Cobbold, Captain A. Gordon, Major F. Dagger, Mr. J. Len, Mr. W. Woods, Lieutenant W. Frost, Lieutenant E. Hughes, Captain D. McLeod plus their mascot.

Captain J. F. Hutchings — the commander in charge of the naval side of Pluto — inspects the control board which indicated the flow rate of fuel in each pipeline to France. With him are Major Dagger and Captain Gordon. (IWM)





The pumps were hidden inside bungalows along Coast Drive. In this shot, Nos. 30, 31 and 33 were pump houses with No. 32 a billet for army personnel. Camouflaged corrugated iron sheds protected the valves in their sunken chambers.


HAIS 1 Laid by H.M.S SANCROFT Oct. 10th '44
2 " " " 13th "
3 " " " 24th "
4 LATIMER Nov. 1st "
5 " 2nd "
6 ALGERIAN 24th "
7 LATIMER Dec. 16th "
8 " 17th "
9 " Jan. 8th '45
HAMEL 3 MARAUDER 17th "
HAIS 10 SANCROFT 22nd "
HAMEL 4 BUSTLER May 7th "
5 " 19th "
6 " April 3rd "
7 " 18th "
8 " 26th "
HAIS 11 SANCROFT May 24th
NAUTICAL MILES
3 4 5 6 7 8 9 10
BOLOUGNE

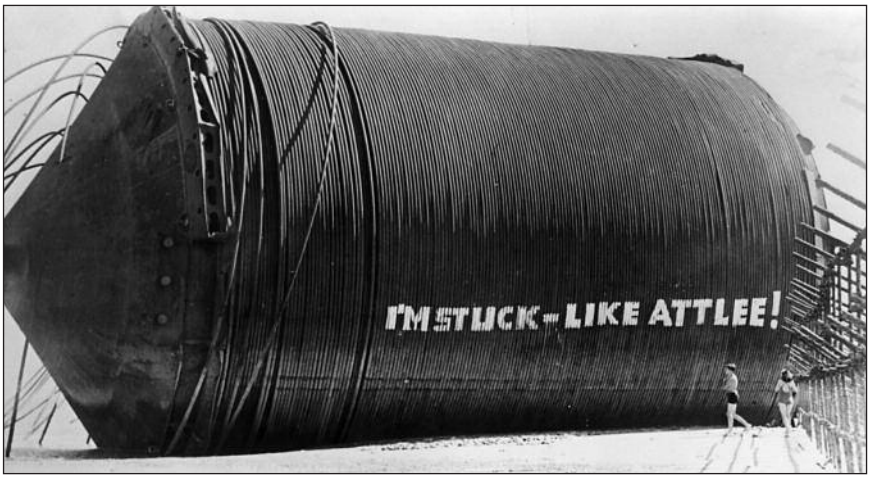
Undoubtedly remnants of the Pluto workings still exist below ground at Dungeness. Relics visible on the surface include smashed concrete and pipe clamps *(below left).*

Below right: **A section of Dumbo pipe protrudes from the shingle. A mouse has now made it home although we could not tell if it was Minnie or Mickey!**

While the Navy and Army parties strived to get to grips with the laying, bringing ashore and connecting up of Hais, in September 1943 the first Conundrum was launched at Tilbury. It was some months, however, before initial winding problems could be overcome. In fact, the Conundrum was overloaded, carrying some 70 miles of pipe for the run from the Isle of Wight instead of some 30 miles for the run from Dungeness. With a spindle 60 feet long and 40 feet in diameter, this entailed 17 layers of pipe being wound around it, which made its overall weight some 1,600 tons.

The Navy acquired one of the most powerful tugs available, HMS *Buster,* but she could only manage three knots towing the Conundrum. Mulberry and the invasion were in the offing, and to obtain another powerful tug when they were in such demand required an approach to Churchill's Chief-of-Staff, General Sir Hastings Ismay, for it was said that the Prime Minister kept a list of these vessels in a locked desk drawer and sanctioned their use personally. Ismay was the key to the problem (if not the supposed drawer!), producing HMS *Marauder.* Her four knots with the Conundrum in tow were an improvement, but hardly enough. The National Physical Laboratory went back over their calculations and the Navy sought to come up with an answer. Then someone suggested that perhaps it was worth considering spacing out the tugs so that their wake flowed past outside the drum, not against it as this was merely pushing the drum backwards in inverse proportion to the effort to pull it forward! Thus, another 3 or 4 knots were achieved — enough to surmount the crisis.

HMS *Conundrum I* was brought from the Thames through the Straits without causing the Germans to sit up and take notice and eventually arrived at Bournemouth Bay for Hamel's dummy run. A 12-mile lay was accomplished, in a loop, the ends being brought ashore, connections made and petrol pumped through.



The one that got away! Walt Disney finally comes to grief at Greatstone — Clement Atlee being the Deputy Prime Minister before the election in July 1945. The two swimmers give a good idea of the size of the Conundrums, six of which were constructed to float the Hamel pipe across to France. 'However, the method of pulling in the Hamel shore ends from the Conun proved difficult and involved the loss of one Conun', explains Arthur Hartley. 'In the end a solution was found by winding turns of Hais cable at the beginning and end of each length of Hamel, followed by a special floating wire. The Conun could then be handled like the cable ship, laying each end on the bottom for the barges to pick up and connect to the shore ends in the same way as for a complete Hais. This technique enabled the first Hais-Hamel line to be commissioned in January 1945.'

Not until three months after D-Day did petrol finally arrive in Cherbourg through the first Bambi pipeline but far too late to influence the battle for by then Allied forces had reached the Pas-de-Calais. Bambi was therefore shut down and priority given to Dumbo which came ashore at Boulogne. It had been intended to make landfall at Ambleteuse but to save time clearing the heavily-mined beach there, another location was chosen inside the outer harbour at Boulogne.

IN RETROSPECT

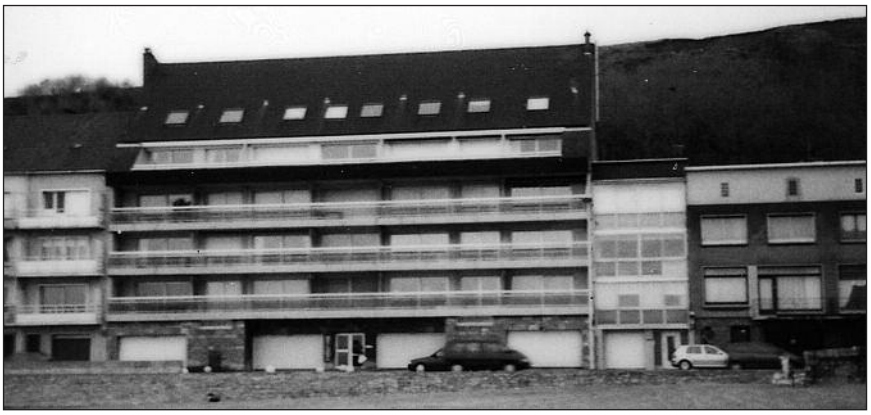
Like the Mulberry harbour, the Pluto pipeline was lauded as a unique achievement when its existence was revealed at the end of the war, and the project has since been invariably regarded as an ingenious idea successfully implemented for the benefit of the advancing Allied armies. Ingenious it undoubtedly was, not to mention ambitious and spectacular. But it was of course the fate of all such Miracles of Modern War — as they were referred to in print during the post-war decade — to come in for later, more critical appraisal; and, without being needlessly disparaging, it is instructive to contrast the legacy of that era with the assessment of the actual performance of Pluto that appears in the volume on the subject of oil in the British official history series.

In the five months after D-Day (between June and October 1944), Pluto delivered only 3,300 tons of petrol to the Continent. The target dates of D+12 for the first line and D+75 for the completion of the Bambi system came and went. Even after Cherbourg had been taken on July 1, a whole month lapsed before the first cable lay was made by HMS *Latimer* while it was considered whether the pipeline should terminate outside or inside the harbour (outside making discharge more difficult, inside endangering the harbour) until nearby Naqueville Bay was decided upon. The first attempt, on August 12, went wrong in Sandown Bay when the 3-inch Hais cable was snagged by an escort vessel's anchor while preparations were being made to bring the end of the return line ashore. Two days later, HMS *Sancroft* set out for Naqueville with the second cable only to face problems when the cable became wrapped around a ship's propeller. There were difficulties in effecting the connection ashore and also leaks were detected.

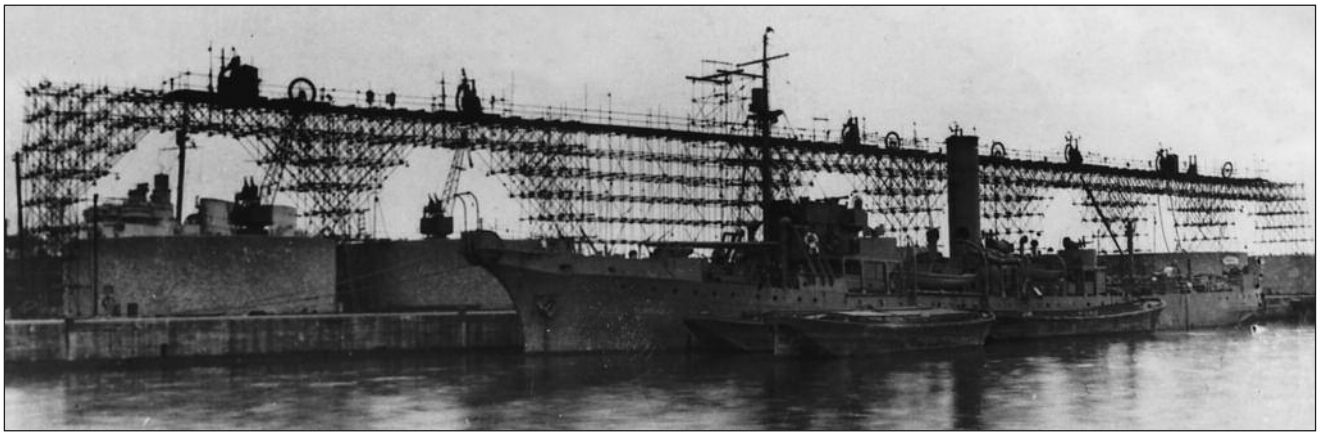
On August 27, the first Hamel pipe was unwound across the Channel from its Conundrum, which by now rested still lower in the water with the addition of tons of barnacles. It was a failure; so was the second attempt; and on the third the pipe broke about 30 miles off the Cherbourg peninsula having probably fouled the drum. It caused great damage to the drum and a replacement, aptly called *Conundrum II*, had to be launched before a new attempt with Hamel could be staged.

Eventually, on September 18, a Hais cable was successfully laid, brought ashore and connected up. Water was pumped through for testing and on September 22 the line was brought into commission, delivering 56,000 gallons of petrol a day at 750lb per square inch. On the 29th a Hamel pipe was successfully laid, tested with water and came 'on flow'. However, neither of them operated for long. During the night of October 3 when it had been decided to increase the pressure on the Hais cable, the pressure indicators suddenly went wild — from registering over 1,000lb per square inch they dropped to almost zero and the line had to be shut down. Later, it was discovered that the trouble lay with one of the couplings. That night, pressure was lost on the Hamel pipe too.

With Le Havre in Allied hands by then, as well as Cherbourg, the effort of continuing with Bambi hardly seemed worth it. The Bambi operation was closed down and, since the Pas-de-Calais had been overrun and the German cross-Channel guns silenced, attention was switched to the Dungeness system, Dumbo. As soon as the approaches to Boulogne had been cleared of mines, HMS *Sancroft* made the first run with Hais on October 10 and pumps started on October 27. Other lays were made by *Sancroft* and *Latimer,* but once more, progress was slow. Problems continued to arise in bringing the ends of cables ashore, and, to begin with, these were exacerbated by the shallow beach at Dungeness which made it difficult for the Navy to deliver the cable to the Army at the high-water mark. The weather too caused delays — rough seas and gale warnings obliging the laying ships to run for shelter, and fine days were lost when the ships were unable to get back into position quickly enough to take advantage of them. There was much changing of plans and waning of enthusiasm. By mid-December, Dumbo consisted of just six Hais cables (four 3-inch, two 2-inch), four of them in operation at low pressures of 350 to 400lb per square inch. Daily deliveries amounted to no more than 700 tons of petrol (the plan to pump aviation spirit from Wye was not implemented) and the total for the 88 days to January 20 was only 62,000 tons.



David Davies of the Batterie Todt Museum kindly provided the comparison taken on the Boulevard St Beuve.



The Navy questioned whether it was worth going on with Pluto in view of the number of ships and men involved. A committee of the Joint Administrative Planning Staff ruled that it was. To put the question into context, Antwerp although under bombardment from flying bombs and rockets, was receiving one ocean tanker a day, while Ostend and Le Havre were each receiving small tankers bringing in some 2,500-3,000 tons a day. Cherbourg and Antwerp alone were capable of taking ocean-going tankers, but supplies could not be stepped up through them; Cherbourg was already working flat out and Antwerp could not be risked further. Small tankers were needed for the Far East and had to be conserved.

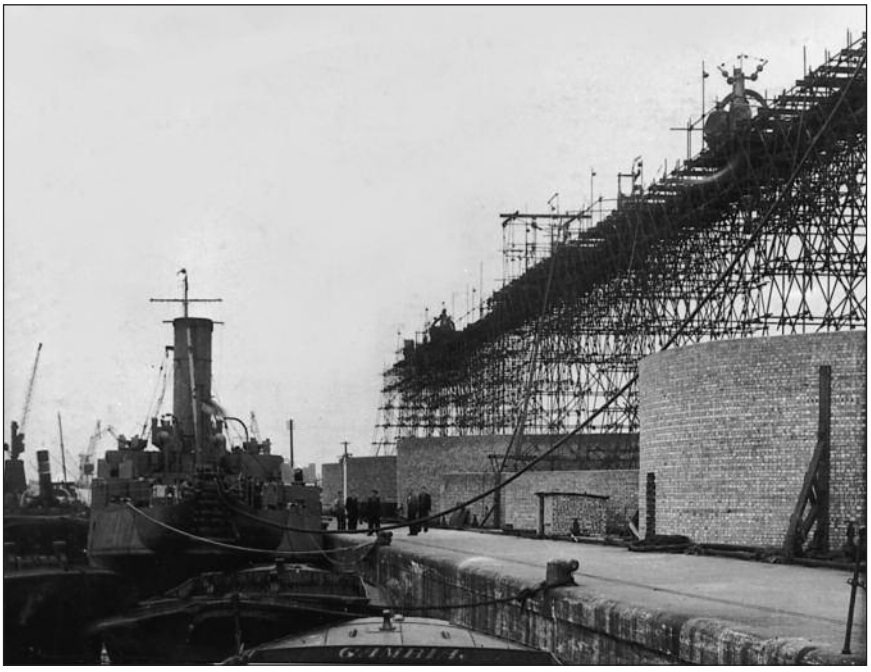
The planners' intention was for all the Hais cable to be used up for Dumbo. (In all, 710 miles of Hais had been produced, 140 of which by cable factories in the US.) The system still lacked Hamel, as the steel pipe had proved impossible to lay successfully until a new technique to land it was used in January 1945. This consisted of coupling a length of Hais cable to the end of the relatively inflexible pipe at the start of the lay, the Conundrum being towed at the French end right into Boulogne harbour for the pipe to be cut and drawn off while the drum was moored alongside the jetty. Subsequently, Hais was used at the finishing end as well, so that there was no need to berth the drum. This adaptation was called the Hais-Hamel system. Another five Hamel lays were authorised by the planners in mid-February in order to achieve the maximum saving of small tankers.

Thus, Dumbo pipelines continued to be laid during the final months of the war (one 3-inch Hais cable being laid as late as May 24, three weeks after the Germans had surrendered, as the quickest way of clearing the cable ship in which it was wound). By then, 16 lines ran from Dungeness: eight 3-inch and two 2-inch Hais cables and six 3-inch Hamel pipes.

'Each 3-inch line at Dungeness', wrote Arthur Hartley after the war, 'could deliver about 400 tons a day, or 120,000 gallons, and lines were laid quickly enough to keep ahead of the capacity to pump beyond Boulogne. Eventually 11 Hais and six Hais-Hamel lines were laid with a capacity of more than 4,500 tons or 1,350,000 gallons a day; and 1,000,000 gallons a day were pumped across for many weeks.

'No Hais cable which had been satisfactorily laid and commissioned failed; and the post-war recovery operation to clear the beaches showed the cable to be in good and usable condition. The Hamel pipes, on the other hand, while more than fulfiling the original estimate of six weeks of useful life, did fail successively in 77, 52, 55, 112, 55, and 60 days. However, in spite of these failures the loss of petrol between tanks at Dungeness and at Boulogne was less than 1.1 per cent for the whole operation.'

Back in Britain, storage of the Hais pipe at the factories along the Thames was proving a real problem so additional space was found in London's East India, Surrey Commercial and King George V docks *(above)* **even though this involved double handling. At first, cable was just piled on open ground but in view of the risk of damage by bomb splinters, protective walls of brick were built. And, of course, it involved the erection of an elaborate gantry to unload and load the cable vessel.**



Seven brick storage chambers at the King George V dock were built on No. 1 Berth.

No trace of the Pluto constructions today. In the background the eastern end of the runway to London's City Airport built in 1986-87.

In this early post-war shot of the King George V dock, the storage chambers on No. 1 Berth, just to the right of the lock, still appear to contain unused cable. On the left one can see the bomb sites of Silvertown hit on Black Saturday (September 7) in 1940. In the foreground repairs are taking place on the bascule bridge on Woolwich Manor Way struck by a flying bomb on February 10, 1945 (see *The Blitz Then and Now,* Volume 3, page 525). (MD)

In July, Dumbo was closed down to save technical manpower. In the words of the volume of the British official history on the subject of oil: 'Perhaps the most trenchant epitaph on Pluto is provided by a few figures of comparative achievement. Down to the end of German resistance on May 10, 1945 about 5.2 million tons of oil products were delivered to the SHAEF area through the ports of North-West Europe. Of this, about 826,000 tons came direct from across the Atlantic and 4.3 million tons, or 84 per cent, was delivered across the Channel from England. Pluto's contribution was only 370,000 tons, less than 8 per cent of the cross-Channel supplies. This was the equivalent to an average daily rate of under 1,800 tons a day from the time when pumping began.'

Nevertheless, the Supreme Allied Commander, General Eisenhower, described Pluto in his report as 'second in daring only to the artificial harbours projects', and wrote: 'This provided our main supplies of fuel during the winter and spring campaigns'.

In all, Pluto delivered 172 million gallons to the Allied armies of liberation, the fuel at Boulogne eventually being pumped on through Ghent, Antwerp, Eindhoven and across the Rhine — a distance of 200 miles. After the war, there was a desperate requirement in Britain for raw materials — notably lead — so salvage work began to recover the pipeline, an operation that lasted until July 1949. *Left:* Of the original 23,000 tons of lead in the Hais pipe, 22,000 were recovered and of the 5,500 tons of steel used in Hamel, 3,300 tons were lifted from the seabed *(above)*. Coming at a time of strict petrol rationing, the discovery that the recovered pipework still contained some 75,000 gallons of fuel was a real bonus!

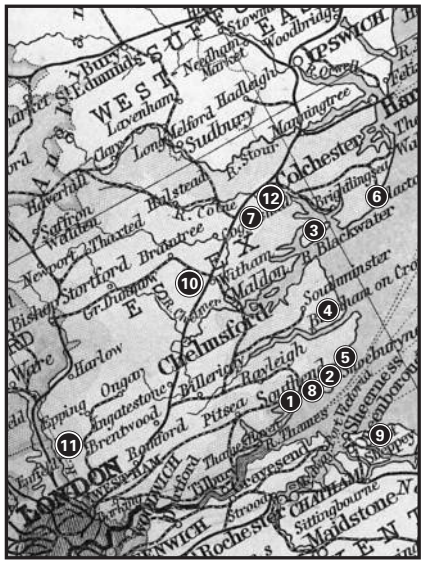
The 'Two Sugars' beach cafe at West Mersea, near Colchester, formerly the casemate for a 4.7-inch coastal artillery gun. Wartime records show that the gun was manufactured in 1918 — in Japan!

Part of a road barrier at Nazeing, a concrete anti-tank block and steel "hairpins" formed from bent railway lines.

The Eastern Command Line was one of four major lines of defence crossing Essex, each of them defended by pillboxes every 200/300 yards. This infantry pillbox stands on the bank of the River Stour at Great Henny.

The Pickett-Hamilton elevating fort was a mini-pillbox designed to be sunk flush into the ground beside an airfield runway. If the airfield was attacked, it could be raised hydraulically by its crew. Few Pickett-Hamiltons are thought to now survive but there are, amazingly, three at North Weald.

In the event of an assault on the GHQ Line, the bridges over the River Cam at Audley End would have been blown. Not only are the mining chambers still there but the detonation wires are still in position!



WORLD WAR TWO DEFENCES IN ESSEX

By Fred Nash

In 1993, Essex County Council began a project to locate, visit and record the many defence works built across the county during the Second World War (see *After the Battle* No. 107, page 11). One of the first counties to tackle such a project, the task was undertaken by Fred Nash, a specialist in the field of 20th-century defences. The project has been extremely successful with unprecedented local interest for a single heritage undertaking. Over 700 letters and phone calls have been received (mostly from Essex people, but some from further afield) with details of surviving pillboxes, anti-tank obstacles and gun emplacements.

During the past nine years, over 1,600 sites have been visited, documented and photographed in a project which not only is widely acclaimed as the most comprehensive and detailed record of a county's wartime defences, but has been called 'a model of its kind' by the former head of the Council for British Archaeology.

From the many sources of information, including wartime archive records, it is now known that there were around 3,000 defences awaiting a German invasion of Essex. So, the work goes on, and with over half of them tracked down so far, this seems an appropriate moment to catch up with Fred for a review of the progress of the project and an insight into some of the fascinating stories and curiosities which have come his way during his travels through the county's wartime past.

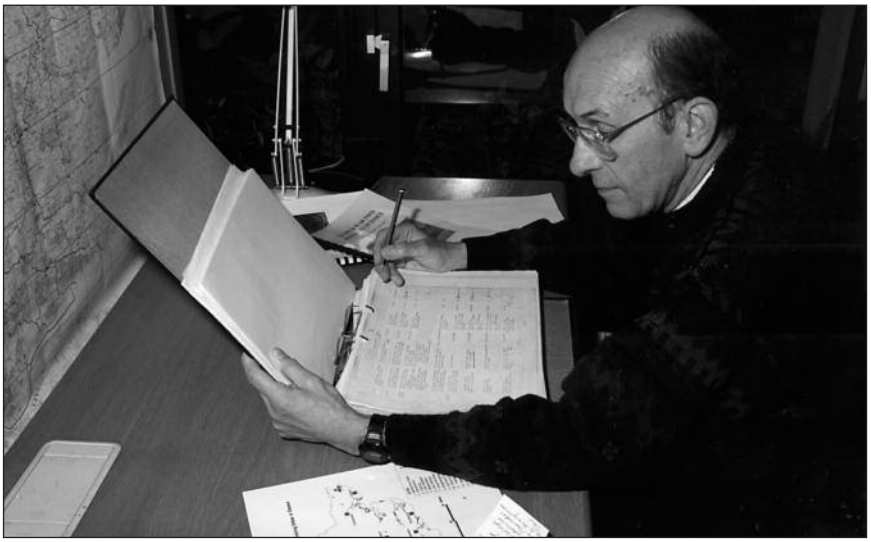
During the Second World War, Southend [1] at the mouth of the River Thames, was the most heavily-defended area in Essex. The estuary would have provided a German invasion force with a sheltered deep-water anchorage with gently-sloping beaches giving easy access to the town. Southend airfield would have been the target for paratroops and the new A127 arterial dual carriageway, built just a few years before the war to supplement the old A13 to carry holidaymakers eastwards from London, would have proved ideal for panzer divisions advancing westwards. Anti-tank obstacles (on the left in the *top* picture) were constructed along the promenade, supplemented with barbed-wire entanglements, (the example *below* shows German prisoners removing the wire on Shoebury Common) [2], with every road, alleyway and exit from the seafront blocked by a concrete and steel barrier. Two 6-inch guns were emplaced in concrete casemates at Shoeburyness and an 'anti-boat' boom six miles long, with 'gates' for the passage of friendly shipping, was strung between Essex and Kent to seal off the Thames. (Southend Museums Service)

Nine years ago, one of the first priorities had been to establish exactly what were 'defences'. Obviously, pillboxes, gun emplacements, anti-tank obstacles, Home Guard defence sites and anti-aircraft gun sites should all be included but what about anti-tank ditches, ammunition dumps, air raid shelters, slit trenches and minefields? Should we include searchlight emplacements, radar sites or army camps? In the event, a list of about 20 types of military structures was agreed.

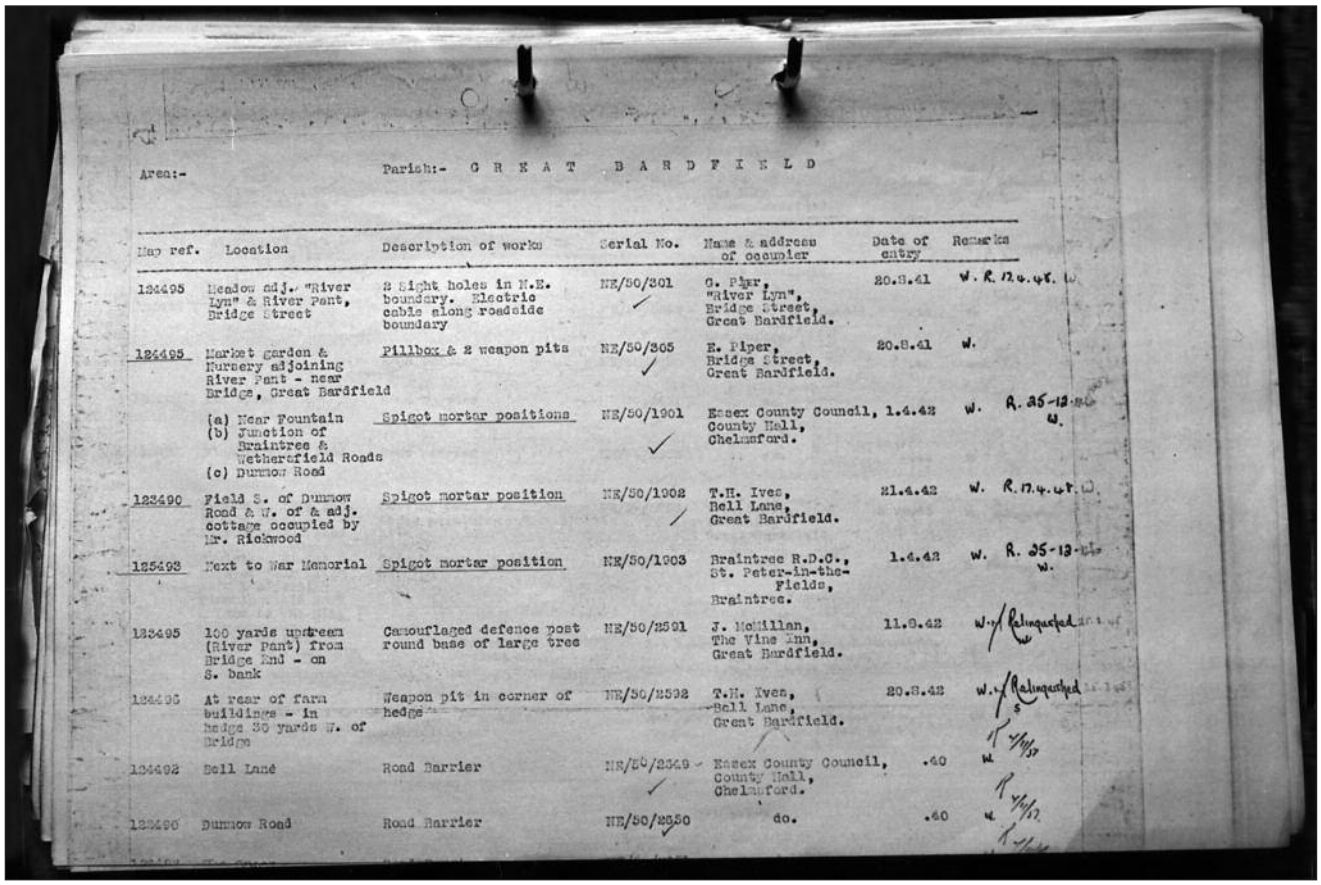
The next question was, how many were there likely to be? A recent survey in Hertfordshire (see *After the Battle* No. 81) had revealed 200 sites but the Essex survey was going to be geographically larger and much wider-ranging in the types of defences to be recorded. Every known example, within the selected categories was going to be tracked down and documented, whether it stood in all its pristine glory or whether it had long since been demolished in favour of a multi-storey car park. Only in this way could the whole wartime defence picture be seen and surviving examples be judged on their rarity or importance. One of the long-term aims was to get some of them preserved for posterity – at that time the legal protection of Second World War defences was very, very rare – and an accurate assessment of the remaining sites was going to be essential.

In the early days, estimates of the numbers built during the six years from 1939 to 1945 ranged from 800 to 1,200. Then some months after the start of the project, the goal posts moved. Or, rather, they leapt violently sideways. The event which caused this dramatic change, in effect the tripling in size of the project, was the discovery of a copy of the wartime records of Essex's home defences. In two huge, dusty ledgers, this extraordinarily rare archive, quite possibly unique in Britain, lists, parish by parish, the pillboxes, road barriers, anti-tank blocks and gun emplacements built on private land during the war. What the purpose was is still open to some speculation but it is known that, in East Anglia at least, every site on private land, even those covering a single slit trench or a roll of barbed wire, had an individual file. All the correspondence on that site was held there and the record which has survived – 800 foolscap pages, all typed out with map references, locations and owners – appears to have been an index to those files. It isn't complete by any means. There may well have been half as many sites again on public land and military establishments, but it is, nevertheless, an amazing record of a county's wartime defence measures. With this discovery, combined with aerial photographs from the 1940s and the support and memories of local residents, it suddenly became possible to document, with great accuracy, a county's entire defence system, something which would be virtually impossible anywhere else in the country.

And so the challenge was taken up. Almost continuously over the past nine years the project has pressed on, covering the miles and miles of inland defence lines, the long coastline from Tilbury to Harwich, the many heavy anti-aircraft gun sites, the big-gun coastal artillery batteries and the mysterious bombing decoys. Of the estimated 3,000 sites over 1,600 have been surveyed so far, about a third of which still survive.



In 1993, with the upsurge of interest in the history of the Second World War, Fred Nash was charged with the task of compiling a written and photographic record covering all the defences in Essex. One can imagine his excitement when he discovered the original wartime records, listing virtually every defence work together with its location, type, and landowner. The records are so comprehensive that they must make the county unique in Britain.



Area:- Parish:- G R E A T B A R D F I E L D

Map ref.	Location	Description of works	Serial No.	Name & address of occupier	Date of entry	Remarks
124495	Meadow adj. "River Lyn" & River Pant, Bridge Street	2 Sight holes in N.E. boundary. Electric cable along roadside boundary	NE/50/301 ✓	G. Piper, "River Lyn", Bridge Street, Great Bardfield.	20.8.41	W. R. 12.4.42.
124495	Market garden & Nursery adjoining River Pant - near Bridge, Great Bardfield	Pillbox & 2 weapon pits	NE/50/305 ✓	E. Piper, Bridge Street, Great Bardfield.	20.8.41	W.
	(a) Near Fountain (b) Junction of Braintree & Wethersfield Roads (c) Dunmow Road	Spigot mortar positions	NE/50/1901 ✓	Essex County Council, County Hall, Chelmsford.	1.4.42	W. R. 25-12-42 W.
123490	Field S. of Dunmow Road & W. of & adj. cottage occupied by Mr. Rickwood	Spigot mortar position	NE/50/1902 ✓	T.H. Ives, Bell Lane, Great Bardfield.	21.4.42	W. R. 17.4.42. W.
125493	Next to War Memorial	Spigot mortar position	NE/50/1903	Braintree R.D.C., St. Peter-in-the-Fields, Braintree.	1.4.42	W. R. 25-12-42 W.
123495	100 yards upstream (River Pant) from Bridge End - on S. Bank	Camouflaged defence post round base of large tree	NE/50/2591	J. McMillan, The Vine Inn, Great Bardfield.	11.8.42	W. Relinquished
124496	At rear of farm buildings - in hedge 30 yards W. of Bridge	Weapon pit in corner of hedge	NE/50/2592	T.H. Ives, Bell Lane, Great Bardfield.	20.8.42	W. Relinquished S.
124492	Bell Lane	Road Barrier	NE/50/2549 ✓	Essex County Council, County Hall, Chelmsford.	.40	W.
123490	Dunmow Road	Road Barrier	NE/50/2550 ✓	do.	.40	W.

The dual-role pillbox discovered at East Mersea [3] near Colchester. A Lewis gun was most probably mounted on the concrete pillar in the rooftop firing position.

There are over 500 pillboxes still surviving in the county. One of the most interesting types has an anti-aircraft machine-gun well built into the top. The gun, probably a Lewis gun from the First World War, would have been mounted on a concrete post in the centre. Trawling through wartime documentation at the Public Record Office, the following wonderful installation note surfaced: 'There are several types of these dual role Pill Boxes in different Batteries. The best is a circular type with raised platform for the mounting (usually a concrete pillar with a hole central into which a traversing and elevating attachment can be placed to hold a gun. A bicycle front fork makes a good one)'. This was issued by South Eastern Command on March 15, 1941 — eighteen months after the outbreak of war!

One of the most impressive structures documented is the massive minefield control tower at Burnham-on-Crouch. At the time, this was thought to be the last remaining example of its type in Britain. Only very recently have we been sent photographs of another one in Scotland overlooking the Sound of Kerrera, three miles south of Oban.

Photographs discovered of Clacton's coastal defences included pictures of soldiers working on an anti-invasion scaffolding barrier which was erected in the sea as a defence against landing craft and tanks trying to gain a foothold on the beach. It was thought that there could not possibly be any remains of anti-tank scaffolding anywhere in Essex . . . but there is! A survey of Ministry of Defence land at Great Wakering has revealed the astonishing sight of hundreds of yards of surface-level remains snaking its way across the mudflats. The wartime existence of an anti-invasion 'fence' along this stretch of the coastline was first detected on aerial photographs taken in the 1940s but no one really thought that anything could possibly have survived. After the war, or more probably towards the end of the war, the steelwork was all cut off at ground level and removed but the horizontal base struts and their linking shackles still remain. Protected by the access restrictions of the artillery testing range these rare, albeit rusty, features have survived to the present day – almost certainly the finest remains of their type in Britain.

This impressive structure at Burnham-on-Crouch [4] once controlled the minefield protecting the approach to the river.

Although remnants of anti-invasion scaffolding emerge from the sea from time to time (see issues 72, page 41 and 100, page 26), Fred discovered a section very visible along the shore at Great Wakering [5] *(left)*. **The wartime picture** *(right)* **shows the erection of this type of defence further north between Jaywick and Clacton [6]. Butlin's holiday camp (since demolished) with its Big Dipper can be seen in the left background. Nothing remains of this section today and even the breakwaters have been removed to be replaced by stone groynes. The Martello tower dates from the Napoleonic War although most were brought back into use as look-out posts during the Second World War. (IWM)**

The rare 29mm spigot mortar (see *After the Battle* No. 81). This pair were discovered at Lexden [7], the one illustrated *(left)* on the corner of a playing field and that *(right)* in the flower bed of a local front garden.

Around the north-east of Colchester the River Colne acted as a natural anti-tank barrier. An earlier phase of the project had found that less then ten of the original 60 defences along this stretch still survived. No Home Guard spigot mortar emplacements had been found, which was somewhat surprising since we had the wartime records, knew where to look, and expected at least one to have made it to the present day. However, during the past few months, most of west and south Colchester has been investigated and two of these fascinating concrete gun emplacements have been discovered at Lexden, complete with their mounting pedestals and stainless steel locating pins. Not only that, but two more are known to be extant on Middlewick Ranges.

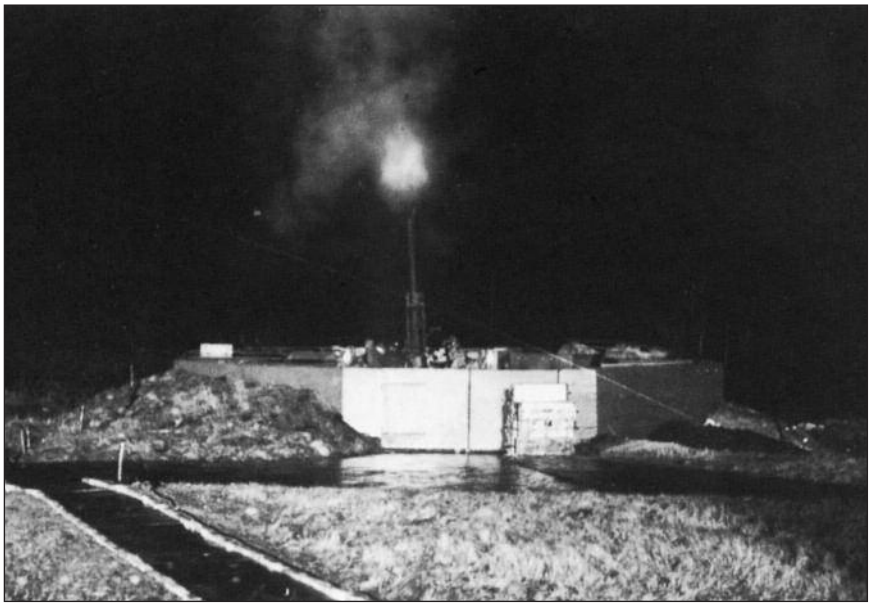
Another striking wartime relic is the 200-foot-long Phoenix caisson designed for the Mulberry Harbour in Normandy which has been stuck out on a sandbank off Thorpe Bay for the past 58 years. It is a C1 type built at Goole, on the Humber.

After construction, the caisson was taken in tow for the long journey down the East Coast, towards its allocated 'parking' place off the South Coast but as it approached the Thames Estuary it sprang a leak. Water was gushing in and the crew contacted HMS *Leigh*, the naval authority at Southend, for instructions. They were told to tow it round into the Thames and beach it on a sandbank. This they did and it is still there today.

Over a hundred of the huge reinforced-concrete caissons were constructed which were to form the semi-permanent breakwater for the two Mulberry harbours off the coast of France. A 20 per cent loss rate was allowed for and several can still be seen stranded off the British coast like this one in Thorpe Bay [8]. (For more detail on the Mulberry harbours see *D-Day Then and Now, Volume 2*.)

Left: **This location was a real conundrum . . . that is until Fred got his teeth into it! The official censored caption states that the picture was taken by Lieutenant Taylor on August 27, 1943 at an AA training centre at Shoeburyness but when Fred examined the picture he knew this could not be correct as that particular corner of Essex is flat as a pancake. So just where was the intriguing picture of gunners aiming at a Spitfire taken? The clue lies in the shadows. Fred realised that from the angle of the sun, the photo must have been taken facing north. In the whole of southern England there are only three places which overlook the sea facing in that direction: the north coast of Devon and Cornwall, the Norfolk coast and the Kent side on the Thames Estuary. Fred already knew that Lieutenant Taylor had taken photos that day at Primrose Hill in north London so this effectively ruled out the West Country and the Norfolk coast. So it had to be somewhere on the north Kent coastline. It couldn't possibly have been too close to London as the Essex coastline would have been in the picture on the far side of the River Thames. How about the Isle of Sheppey? Or Sheerness? A look at the contour lines on an Ordnance Survey map of the area showed that a two-mile stretch just east of Sheerness [9] fitted the bill exactly and a visit to the area confirmed it. (IWM)**
Right: **There has been a lot of coastal erosion here since the war, particularly in recent years, so it proved impossible to take an exact comparison photograph. Much of the grassland over which the Spitfire was flying is now in the sea. However, by backing off a couple of hundred yards it was possible to take a passable match.**

One of the most rewarding aspects of Fred's work is that the powers that be have finally acknowledged the historical importance of the Second World War defence sites for scheduled protection — yet it is not a moment too soon. *Left:* **Fred surveyed this pillbox on British Rail land at White Notley [10] in January 1997. It was a village landmark regarded with great affection by the local residents but, despite representations from the Parish Council, Braintree District Council and Essex County Council, it was unceremoniously demolished later that year.** *Right:* **For what purpose?**



One of the best kept secrets of the war was the construction of decoy bombing sites — dummy airfields, factories, docks and railway yards — built to persuade German bombers to drop their loads onto open countryside rather than their intended targets. The project has tracked down 16 of these sites in the county ranging from dummies of Wrabness mine depot and Harwich naval dockyard to the huge oil refineries on the Thames. The RAF fighter station at North Weald was replicated by a dummy at Nazeing. This was both a daytime site fully equipped with plywood and canvas Hurricanes — provided by Shepperton film studios — and a night-time site with 'runway' lighting and moving headlights.

The survey of the heavy anti-aircraft gun batteries in Essex has had a particularly happy sequel as five sites — Lippitts Hill, Little Oakley, Furtherwick, Northwick and Butler's Farm — have now been granted Scheduled Ancient Monument status by the Department of Culture, Media and Sport. These are among the very first World War Two defences to receive legal protection under English Heritage's Monuments Protection Programme.

But all is not lost. Fortunately for Essex, because Fred's survey work is well advanced, the county was in a good position to present cases to English Heritage for preservation. The first category to be tackled was major gun batteries of which there were originally 40 permanent sites located in Essex covering the full range of AA weaponry: 3.7in; 4.5in; 5.25in and rocket batteries. *Left:* **Probably, the best preserved is ZE7 at Lippitts Hill [11] because it lies within the Metropolitan Police training establishment near Waltham Abbey. The wooden huts, which still stand, were brought into use for housing German prisoners of war who left behind this unusual statue** *(right)* **carved out of a block of concrete. The Lippitts Hill battery is important in another way as it mounted the first American guns to fire in the defence of London during the 'Baby Blitz' in 1944.** *Centre:* **The 90mm M1s were set up in the 3.7in emplacements and manned by Battery B of the 184th Anti-Aircraft Artillery, part of the 54th AAA Brigade, which served in Britain from December 1943 to June 1944.**

There have been a great many surprises during the last nine years and not all of them built of concrete and steel. One of the most fascinating is recalled by a lady from Mersea Island. In 1940 she was stationed at the army barracks in Colchester. One of the cadets at the camp was the songwriter Ross Parker, then in his mid-twenties. The previous year, together with Hughie Charles, he had written *We'll Meet Again* which was to become a wartime favourite sung by Vera Lynn. Now he was in the throes of composing a new song, one which was, like his previous hit, particularly redolent of the times: *There'll Always be an England*. Unable to find the peace and quiet he needed to continue his work, he regularly retired from the noisy barracks to the one place he knew he could be alone – the local pillbox! The rest is history.

Sixty years later, there is every chance that this very pillbox still survives. We know it was in Berechurch. All the wartime defence sites in the area have now been recorded and the three most likely candidates still exist, all close to the barracks. It would be a fitting tribute to both the composer and to Colchester's WWII heritage if Ross Parker's pillbox could be identified and a '*There'll Always be an England*' plaque erected at the site.

Ross Parker composed two of Britain's most evocative wartime songs: *We'll Meet Again* and *There'll Always be an England*, the latter while serving with the army at Colchester barracks [12] in 1940. He found inspiration in the Essex countryside . . . and the peace and quiet he needed to compose while relaxing in the local pillbox. On the trail of Ross Parker's pillbox, Fred found that there were three possibles, all within a stone's throw of Roman Way Camp. This one, a large 'shell-proof' type *(above)* **is in Berechurch Road.**

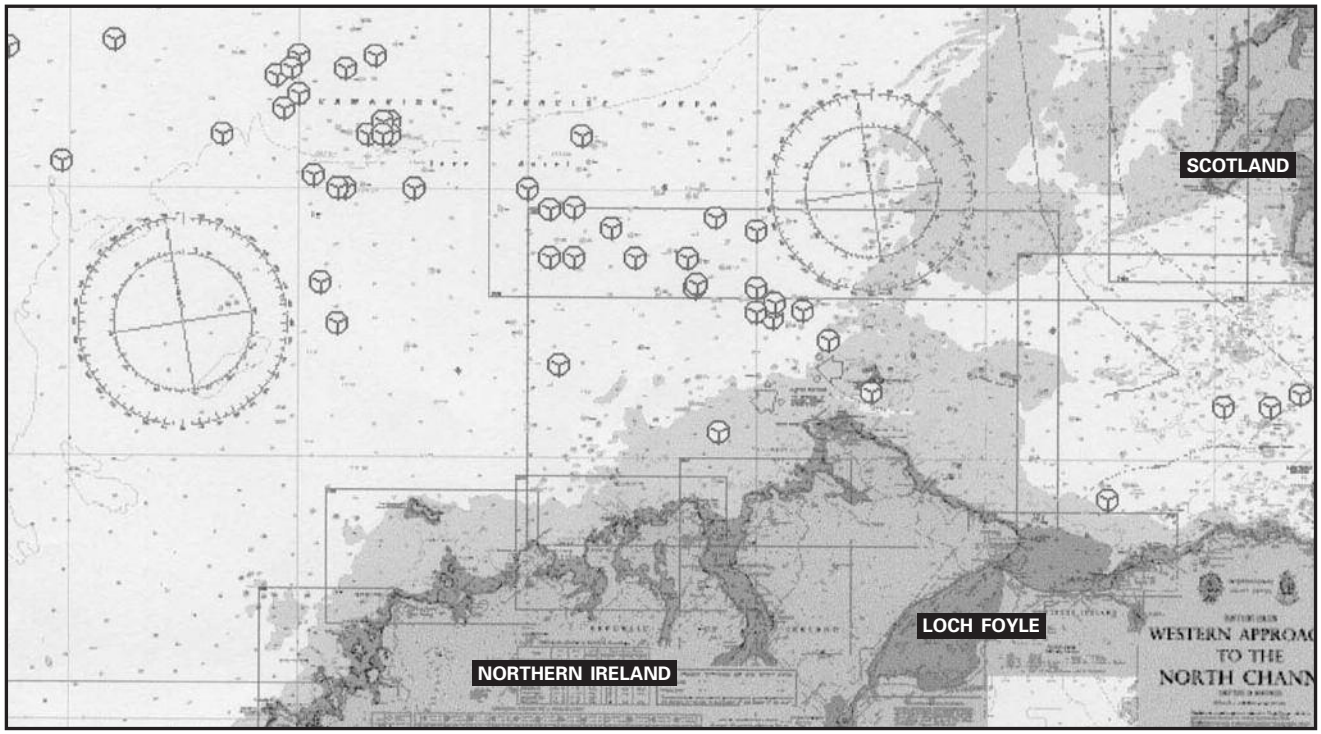
The other possibilities are nearer the camp gates. *Above:* **One lies hidden in the centre of a bush, while the other, a small FW3/22 type** *(below)*, **is less overgrown. Which one shall we choose?**

There'll always be an England,
While there's a country lane,
Wherever there's a cottage small,
Beside a field of grain.
There'll always be an England,
While there's a busy street,
Wherever there's a turning wheel,
A million marching feet.

Red, white and blue,
What does it mean to you?
Surely you're proud,
Shout it aloud,
Britons awake.
The Empire, too,
We can depend on you,
Freedom remains,

These are the chains,
Nothing can break.
There'll always be an England.
And England shall be free.
If England means as much to you,
As England means to me.

ROSS PARKER/HUGHIE CHARLES



Germany began the Second World War with 57 U-Boats and over the course of the war another 1,089 boats were built and commissioned. During hostilities, 830 took part in some 3,000 operations and the U-Boat arm claimed to have sunk over 3,500 merchant ships (although British records state 2,603 vessels lost of which 2,452 went down in the Atlantic). In addition, U-Boats sank 175 Allied warships. These successes cost the Germans 636 U-Boats lost at sea and 63 destroyed in U-Boat bases and yards. Another 85 were lost through other causes, 154 surrendered after the capitulation and 218 were scuttled on the eve of surrender in May 1945. Of the surrendered U-Boats, 28 were distributed between the Allies as spoils of war. The remainder were subject to an Anglo-American-Soviet agreement and to be disposed of by sinking in deep water in the Atlantic (save for odd boats in the Far East like the *U-219* at Batavia, the *U-195* at Sourabaya and the *U-181* and *U-862* at Singapore which were to be sunk locally). Operation 'Deadlight' was to be completed by February 15, 1946.

'DEADLIGHT' U-BOAT INVESTIGATION

By Innes McCartney

In the winter of 1945, the Allies disposed of 116 U-Boats in Operation 'Deadlight' which represented the bulk of Germany's submarine fleet which had surrendered in May of that year. Only 58 U-Boats (exactly half) reached the allocated dumping grounds, all the rest lie at a depth of less than 100 metres.

To the knowledge of the expedition, only a very few of the submarines had ever been visited by divers. Certainly little was known about any of the wrecks and their identities were generally a mystery. In the event, the expedition was able to locate and identify ten U-Boats in the Operation 'Deadlight' area, two of which turned out to be war losses.

With such a wealth and variety of U-Boat wrecks in the 'Deadlight' sinking area, it is very surprising that little attention has been paid to them in the past. With the exception of a plan announced in 1996 to salvage some of the vessels for profit (see *After the Battle* No. 92, page 42), no attempt has been made to try and investigate what lies on the seabed. Although the area has been surveyed to a high standard, the identities of the individual submarine wrecks located was not known and scant interest has been shown in trying to identify those worthy of note. The purpose of the Operation 'Deadlight' Expedition, masterminded by our author, diver/historian Innes McCartney, was to dive on as many of the wrecks as possible in a two-week period and attempt to target those U-Boats which are of particular historical importance. Here the preparations for the expedition are underway at Portpatrick near Stranraer in Scotland.

OPERATION 'DEADLIGHT'

When the Second World War ended, the remainder of the U-Boat fleet fell into Allied hands. The surviving vessels were a mixture of training boats, prototype designs, operational U-Boats, and revolutionary new designs which were working up to operational efficiency during the last months of the war. In essence, the Allies were in possession of every single class of U-Boat built since the end of the First World War including examples of every technological advance the Germans had made during this time.

In order to evaluate the more recent designs, it was agreed that limited numbers of the surrendered U-Boats would be distributed amongst the Allies. The USSR took ten and the other Allies another 18 between them. The tripartite agreement, which led to Operation 'Deadlight' (see *After the Battle* No. 36), was signed by the USA, USSR and Great Britain in August 1945. It stated simply that the remaining U-Boats had to be sunk in waters deeper than 100 meters by February 15, 1946.

The submarines were assembled in Loch Ryan on the Scottish coast and Loch Foyle in Northern Ireland. The decision was made that they would have to be towed to the dumping areas, primarily because of the difficulties of retrieving the U-Boat crews at sea in bad weather, but also because it was recognised that many were deteriorating due to an absence of maintenance since the end of the war. Submarines are notoriously difficult to tow and herein lay one of the reasons why the objectives of the operation were only half-met.

In this British official photograph taken in Loch Eriboll on the northern coast of Scotland, two Type VIIC boats have surrendered. On the right is the *U-826* which was scuttled in Operation 'Deadlight' but the other vessel — given as the '*U-236*' — must be a mis-identification as that submarine had already been damaged by Allied aircraft off Denmark on May 4 and scuttled by her crew.

CONFIDENTIAL.

WARNING.—This is an unparaphrased version of a secret cypher or confident code message, and the text must first be paraphrased* if it is essential to communicate it to persons outside British or Allied Government Services.

***(NOTE: Messages shown as having been sent in a One-Time Pad ("O.T.P.") are excepted from this rule.)**

312344/October

To: C. in C. Rosyth. F.O. S/M

Date: 31.10.45.

From: Admiralty.

It is intended to scuttle 86 U-boats from Loch Ryan and 24 from Lisahally in position 56 degrees North 10 degs. 05 mins. West.

2. A large proportion of these will require towing and therefore as many destroyers, escort vessels and tugs as can be spared from other commands will be sent to assist. Further signal follows.

3. F.O. S/M is requested to make necessary arrangements as regards U-boats in order to meet requirements of C. in C. Rosyth who is requested to control the operation.

4. Approval to commence the operation is expected shortly.

312344

Once the U-Boats had been towed to the allocated dumping areas, they were to be sunk either by demolition charges, torpedoed by HMS *Tantivy* or by aircraft. In the event of bad weather or a failure of the charges, gun-fire was to be used.

The U-Boats were to be disposed of in groups of six. Right from the outset, problems were encountered during towing. The worse the weather, the more the towing cables broke, or the U-Boats simply foundered under tow. In these cases gun-fire was used to sink the submarine. On some days no U-Boats at all reached the dumping area, whilst on other days, most did. The best that can be said about Operation 'Deadlight' was that it was completed before the deadline.

Rather than just scuttling the U-Boats using internal explosive charges, 36 vessels were made available for training aircrews from RAF Coastal Command and the Fleet Air Arm who had not had previous experience attacking U-Boats. Others were to be used for target practise by Royal Navy submarines firing torpedoes. Any which survived these attacks were to be finished off with gun-fire.

Kapitänleutnant Adalbert Schnee *(left)*, awarded the Ritterkreuz in August 1941 when he commanded the *U-201* (see *After the Battle* No. 55, page 44) having sunk a total of 23 ships. He was transferred to U-Boat headquarters late in 1941, the Oakleaves being added to his award the following July. He was specially selected by Admiral Dönitz to command the first of the new Type XXI craft — the *U-2511* *(right)* — which was commissioned on September 29, 1944. Sea trials were cut short so that she could carry out the first Type XXI war mission.

WHY ARE THE WRECKS HISTORICALLY IMPORTANT?

While many of the wrecks are 'run of the mill' U-Boat types, some are of undoubted historical importance. These fall into two distinct categories.

First are those late-war designs made up of the Type XXI and Type XXIII 'electro-boats'. They were revolutionary designs — the world's first true submarines — having the ability of operating underwater throughout an entire patrol. The increased number of batteries allowed these boats to run submerged at high speeds and indefinitely, being fitted with the Schnorchel breather tube to enable recharging underwater. The smaller Type XXIII was used in operations along Britain's East Coast at the end of the war, with limited success. However the larger Type XXI was potentially a severe threat to the Allies. It had a vast range and would have been a menace on convoy lanes in the Atlantic, where it would have been difficult to locate and hunt down. The *U-2511*, the only Type XXI to approach an Allied convoy before the war ended, is among the wrecks of Operation 'Deadlight'. (The *U-3008*, another Type XXI, was also on patrol at the end of the war — see *After the Battle* No. 111, page 37.)

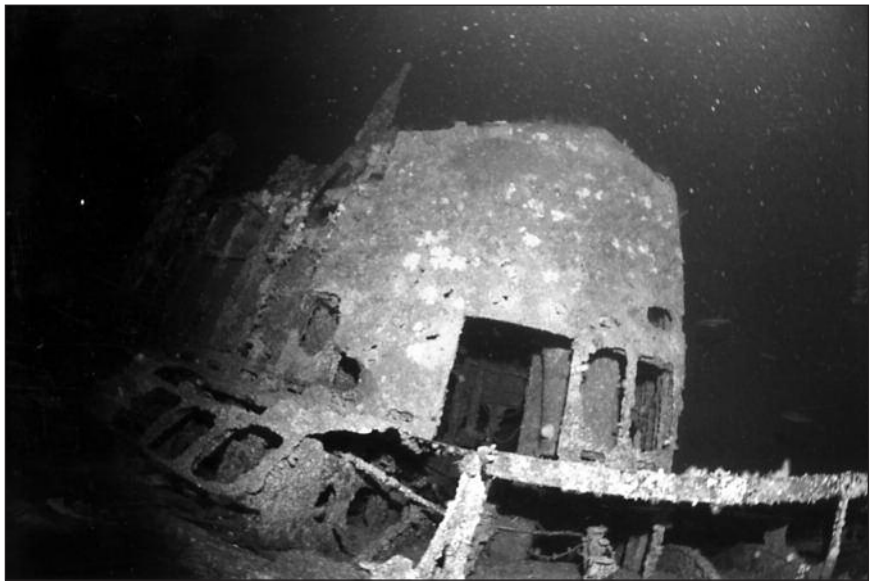
Then there are the highly successful wartime U-Boats. Interestingly, on some occasions, the German Navy tried to ensure that once a U-Boat had become a success it was not put at risk of destruction by the Allies as this was considered to be bad for national morale. As a result these U-Boats were often relegated to training roles. There are others among the 'Deadlight' fleet that have connections with famous commanders, too. Some examples include U-Boats commanded by Knight's Cross holders, such as Adolf Piening, Heinrich Lehmann-Willenbrock (the commander around whom the film *Das Boot* was based), Adalbert Schnee and Jürgen Oesten.

Many of these wrecks lay in depths that the expedition could reach so to locate and explore some of the more famous was one of the key motivations behind the project.

Blessed with great weather, in July 2001 the expedition was able to dive on ten different wrecks. It turned out that eight were 'Deadlight' U-Boats and two were U-Boat war graves from World War Two. Of the former, six are thought to be *U-2511, U-218, U-778, U-281, U-155* and *U-637*. Two other Type VIIC U-Boats could not be satisfactorily identified.

Four of these wrecks in particular resulted in fantastic dives as the targets themselves are historically important.

How fascinating to rediscover Schnee's submarine now on the seabed off the northern coast of Ireland having foundered on its way to the deep-water scuttling area. Here Innes takes underwater video of the wreck which lies at a depth of around 250 feet. A sub-aqua diver can only spend 20 minutes at this depth and then has to spend another two hours decompressing during the return to the surface.



Left: **The conning tower after being submerged for 55 years.** *Right:* **The 30mm Flak gun in its turret.**

U-2511

Alan Wright located the wreck of *U-2511* in 1999. Since then it had not been re-visited until the expedition went there and photographed and videoed it extensively. Diving at midday on Sunday, July 15 in bright sunshine, on descent the wreck became visible at a depth of 45 metres and it was possible to see the entire submarine lying on a white sandy bottom, clearly recognisable as Adalbert Schnee's *U-2511*.

A tour of this wreck reveals that it lies on its port side and is essentially completely intact. The pointed section of the bow has gone and the divers could clearly see all six of the forward torpedo tubes. Continuing along the hull, the torpedo-loading hatch was open. Beyond that, the massive conning tower, which dominates the wreck, came into view. The forward flak turret is still in place, looking absolutely spectacular, as did the slightly raised sky periscope. The conning tower hatch was open as was the hatch that led to the stern flak turret. This has fallen off the tower and lies upside down on the seabed. Aft of the tower, the wreck is complete, all the way to the stern, where the hydroplanes and single rudder are still in position.

The *U-2511* was sunk by gun-fire after her towing cable broke and there is a sizeable shell hole in her starboard side alongside the tower. Swimming into this hole revealed a mass of cabling and many batteries all along the keel section of the wreck. Looking forward, the divers could see the open bulkhead door leading to the forward compartment.

This was one of the most spectacular U-Boat dives we made as it is a rare sight to have such good visibility underwater to see an entire submarine in view at 69 metres. This was made all the more significant by the fact that the wreck was the *U-2511*, the only Type XXI to approach an Allied navy convoy, and perhaps the most historically important U-Boat in the 'Deadlight' fleet. She has now been photographed and filmed for posterity, recording the spectacular, if salutary reminder of the massive jump in submarine design and technology carried out by the Germans during the war.

On the last day of the war, just as she was told to surface and surrender, Schnee spotted a Royal Navy convoy of some destroyers screening a cruiser. To test the attack potential of the Type XXI, Schnee approached the convoy at 16 knots, reached a position where he could not have missed the cruiser, but then turned away and escaped unnoticed.

Interestingly, when one looks at photos of *U-2511* in Norway, or during Operation 'Deadlight', she appears to be a light grey, even white, while the other Type XXIs around her seem to be painted in the standard navy-issue grey. It appears that Schnee had taken a ride in an aircraft over his base in Norway and seen the way that the XXIs stood out from above. He then decided to re-paint *U-2511* with a brighter colour which gave it a higher degree of camouflage. She is therefore the easiest U-Boat to identify from archival photos, being essentially unique.

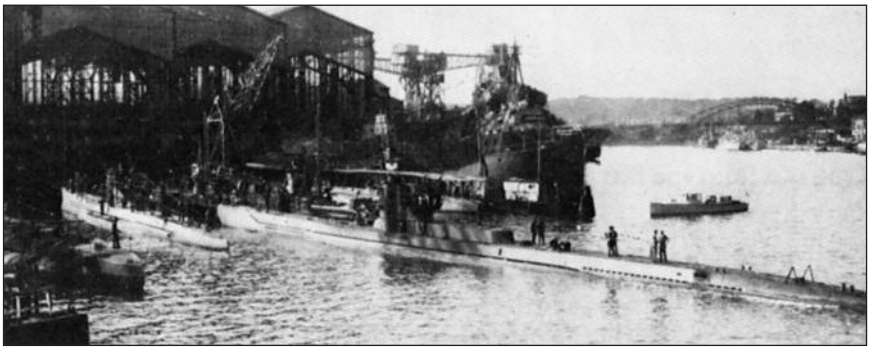
The starboard propeller. The battery power of the Type XXI was trebled compared with earlier boats but still only gave an endurance of 30 nautical miles when running fully submerged at 15 knots. However, with the diesel engines breathing through the Schnorchel, this range was increased to some 285 miles at the lower speed of six knots.

U-218

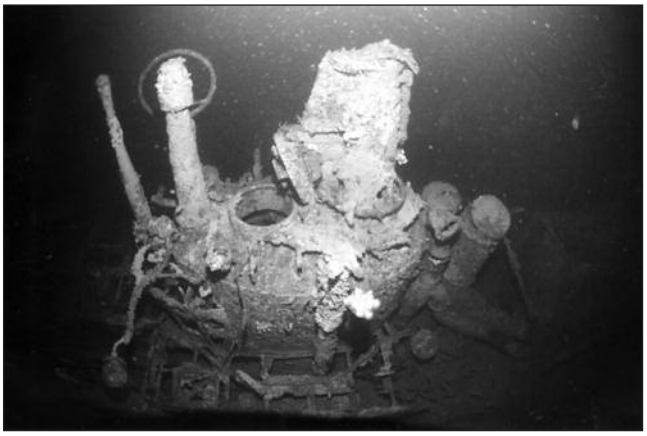
This wreck lies 1½ miles away from its reported sinking position. The *U-218* — one of the very rare VIID minelaying variant designs — foundered under tow while on her way to be expended as an aircraft target.

We found the wreck at a depth of 60 metres in very good visibility with much ambient light. She was an absolutely incredible sight and the superb conditions made for high quality video and stills images.

She lies at an angle with a 45-degree list to port but, apart from minor damage to bow and stern, the U-Boat is completely intact. The five-chute mine section behind the conning tower made this wreck easily recognisable. So far she is the only VIID in the world that has been dived on which made her a rare treat for the diving team.



The *U-218* pictured on August 17, 1942 after final commissioning work had been completed at the Germania shipyard at Kiel.



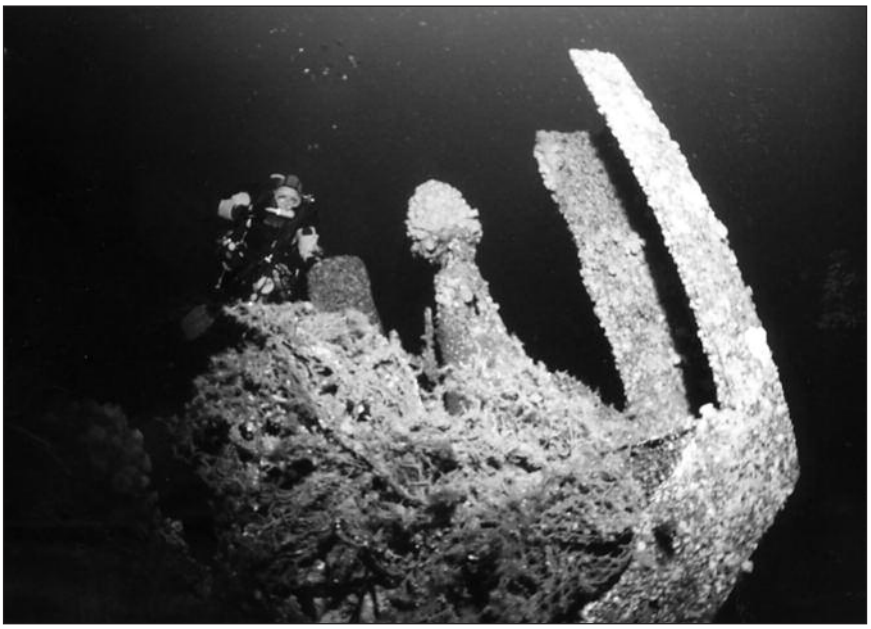
The main difference with the Type VIID was the mine tubes *(left)* fitted behind the tower *(right)*. The D series could carry 15 mines and a minefield laid by the *U-218* off Lizard Head in Cornwall in August 1944 is reputed to have claimed one of the last victims of the war — a fishing trawler sunk two months after the end of hostilities.

U-155

The location of this most famous submarine was one of the key expedition targets and everyone wanted to be the first to dive on Adolf Piening's U-Boat. In stunning visibility at 73 metres, the unmistakable giant shape of the Type IXC was found sitting bolt upright on the bottom. Her forward hydroplanes and torpedo tubes have fallen off to one side, revealing the bow end of her pressure hull but, apart from this damage, the wreck was entirely intact. This included all of the outer cladding attached to the pressure hull which gave this wreck the 'beamy' shape of the Type IX.

The Schnorchel was still in place on the starboard side of the foredeck (with round dipole); the heavily reinforced support for the winter-garden still intact; and the conning tower was hatch open allowing the divers to clearly see into the control room via the opened lower hatch. The aft dingy recess on the deck was empty and both external torpedo doors were shut. This was undoubtedly one of the most impressive dives carried out during the expedition. Piening took *U-155* on several long patrols off Africa, South America and the Caribbean and sank 25 ships in the process. Among them was the aircraft carrier HMS *Avenger* which he sent to the bottom with over 600 of her crew off Gibraltar on November 15, 1942. She was the sixth-largest warship to be sunk by a U-Boat in WW2.

Below: **David Blenkurn swims towards the barnacle-covered conning tower of the *U-155*, the same one once occupied by the legendary Kapitänleutnant Adolf Piening, pictured *(left)* when he won his Ritterkreuz in August 1942. The framework of the bridge can be seen, along with the surface-firing control pillar and double periscope housing.**



Unfortunately, problems with the stills photography prevented pictures being taken of the *U-778* and the *U-1014* but those of the other war grave loss discovered during the expedition are reproduced here. At first, Innes believed they had come across the wreck of the *U-743* which had been depth-charged near the 'Deadlight' sinking area in September 1944. However, further research indicated that it is more than likely that it is the wreck of the *U-1003* which was known to have been rammed in this area by the Canadian frigate *New Glasgow* on March 20, 1945. *Above:* These two views show the remains of the conning tower with the periscope bent over at right-angles and the ready-use ammo locker for the AA guns.

U-778

The wreck of this U-Boat is the most intact that the author has ever seen and it is certainly the finest example of a sunken Type VIIC U-Boat anywhere in the world. The conning tower retains its cladding and all of its bridge equipment — a very rare sight indeed.

The wreck has a mounting for an 88mm deck-gun and it is Schnorchel-equipped. There were no life-raft canisters remaining on the bow.

The *U-778* only made one patrol off Peterhead during the last weeks of the war, sinking no ships, and her newness at the time of her sinking may account for her remarkable state of preservation.

THE WAR GRAVES

U-1014

After a period of bad weather, we left Portrush to dive on what we hoped would be the *U-1014*. She was a Type VIIC launched in January 1944 and attacked by the Royal Navy frigates HMS *Loch Scavaig, Loch Shin*, *Nyasaland* and *Papua* on February 4, 1945. After being depth-charged she was sent to the bottom and we found the wreck to be extremely badly damaged. It appears to have suffered several direct hits as it has been holed in at least three places, reducing the submarine to a useless hulk. It is clear that the crew must have died quickly. The blast holes are in the forward torpedo room, the area around the captain's bunk/sound/radio rooms, and aft of the winter-garden. The damage amidships is so bad that little of the conning tower remains and the hydraulic elevator for the Schnorchel is now lying where the captain would have slept! Only the 'Atlantic' bow and the stern remain undamaged.

The wreck is heavily populated with lobsters and conger eels. And as it is classified as a war grave, we only inspected it from the outside.

U-1003

The team was in the process of attempting to find another Type XXI U-Boat when we came across something very different right on the outer edge of the cluster of 'Deadlight' wrecks. At 69 metres, we found the wreck of a Type VIIC U-Boat which must be a war loss and not one of the 'Deadlight' fleet because:

a) The attack periscope and Schnorchel have been damaged at about the height of the conning tower. The base of the Schnorchel stands upright, still located in its collar on the conning tower, but the attack periscope is bent right over, so that the lens is buried in the seabed.
b) There are closed ready-use ammunition lockers around the collapsed winter-garden area whereas the 'Deadlight' U-Boats were stripped of all ammunition.
c) All the hatches on the wreck are closed suggesting that it was schnorcheling at the time of sinking. There are also no signs of damage to the pressure hull as could be expected if this had been sunk during 'Deadlight' scuttlings.
d) The position does not tally with any Type VIICs sunk during 'Deadlight'.

From the damage to the wreck, it seems likely that this submarine was in a collision while schnorchelling, which resulted in the boat flooding. Other observations made on the wreck included the fact that it had not been fitted with life-raft canisters on the bows and that it seemed to have been constructed to carry a deck-gun as the mounting could be seen forward of the conning tower. There was no evidence of an air radar search receiver on the head of the Schnorchel.

Investigating a wreck that seems to be a war grave was a sombre experience for the expedition divers, and the author, working with the German historian Dr Axel Niestle, first identified this boat as the *U-743* which had been depth-charged by the frigate HMS *Helmsdale* and the corvette *Portchester Castle* in September 1944.

OPERATION DEADLIGHT 2002-3

There are still many U-Boats left to visit for the first time since 1945, and some old friends to look up again, so over time we should be able to build up an accurate record of all the accessable 'Deadlight' wrecks and work toward identifying them all. A huge body of information relating to these wrecks is being assembled and all will be codified into a final report sometime in the future.

For more information about Operation 'Deadlight', the wrecks and the expeditions, and availability of the video of the expedition which includes underwater footage of all the wrecks go to: www.periscopepublishing.com

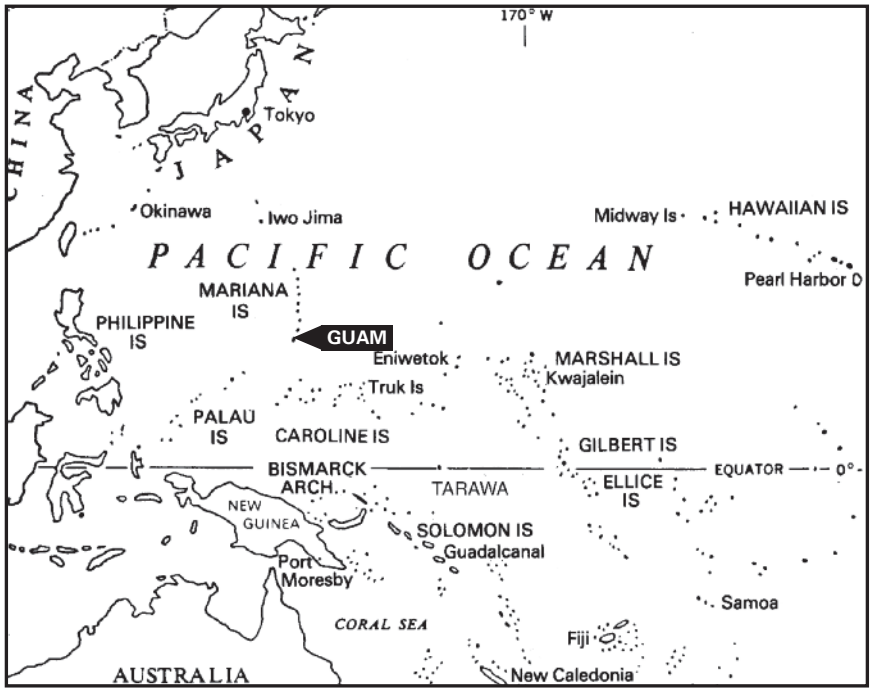
The broken-off Schnorchel lies nearby on the sand.

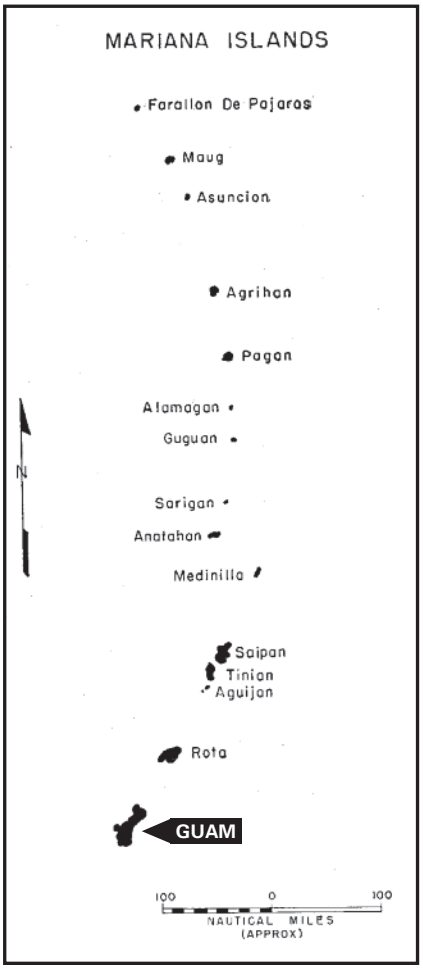
THE RECAPTURE OF GUAM

By D. Colt Denfeld

In issue 89 Colt Denfeld, historian with the US Army Corps of Engineers in Alaska, told the story of the first phase of Operation 'Forager' — the recapture of the Marianas — covering the landings on Saipan. At the time — June 1944 — all eyes were on Europe and the invasion of Normandy but on the opposite side of the globe, men were also fighting on beaches but, in the case of Guam, US marines were landing back on American soil.

Top: **This is Asan Beach — code-named Red, Green and Blue Beaches in the invasion plan — full of the detritus of war. (USNA)** *Above:* **Now the beach area is preserved within the War in the Pacific National Historical Park which was set up in 1978 under the US National Park Service. After the battle, Asan Point in the background was used as a source for construction materials, its shape being altered by quarrying.**





Japan was granted a mandate to administer the former German islands of Micronesia, save for the British Gilbert Islands (which included Tarawa – see *After the Battle* No. 15) and Guam which had been ceded to the United States in the Treaty of Paris in 1898 (along with Cuba, Puerto Rico and the Philippines) for $20 million. Thus, in 1941, the Japanese controlled all the other islands in the Marianas, save for the southernmost Guam, making any defence of a single, isolated and largely demilitarised island some 3,800 miles west of Pearl Harbor, virtually impossible. Although a report in December 1938 recommended Guam as a major air and submarine base with adequate coastal defences, the US Congress shrank from giving its approval lest it offend the Japanese neighbours. Not until 1941 was funding approved for the erection of fuel tanks, harbour improvements, and a survey carried out to find a suitable site for an airfield . . . but by then it was far too late.

Guam is the largest and southernmost of the Mariana Islands. It is thirty miles long and three to twelve miles wide with 228 square miles of rugged mountains and jungle terrain.

Western contact came to Guahan with the arrival of Ferdinand Magellan in 1521, believed to have anchored in Umatac Bay. Magellan's ships were greeted by Chamorros who rowed out to his ships in canoes. Coming aboard, the natives helped themselves to some items so an angry Magellan repaid the island by raiding villages for food and supplies and killing seven men. Still upset, Magellan gave Guahan and the neighbouring islands the name Islas de Ladrones (Islands of Thieves).

Spain formally annexed the Ladrone Islands in 1565. The first 100 years of Spanish occupation witnessed little interest in the island, used as a stopover for food and water as Spanish galleons travelled between Mexico and the Philippines. This changed in 1668 when a permanent Spanish settlement was formed and an effort made to Christianise the native population. The initial friendly reception to the Spanish encouraged the dropping of its perjorative name, Islands of Thieves, and renaming the island group the 'Marianas' to honour Queen Mariana of Austria. Unfortunately the Ladrone Island name remained on many maps even into World War II, but today there is a local initiative to return to the original Chamorro name of Guahan.

When Spain forced dramatic changes in the social culture of the islanders, the relationship between the Spanish and the Chammorros quickly turned sour. Chamorro resistance emerged and a revolt broke out in 1672. The Spanish overpowered the resistance but the warfare, plus the introduction of Western diseases, decimated the island population. In 35 years of Spanish colonial administration, the Chamorro population dropped from about 25,000 to 5,000. The few islanders who survived had been subdued and were now Roman Catholics.

During the 1800s, the population increased and stood at 10,000 when the United States Navy arrived during the Spanish-American War. On June 20, 1898, the USS *Charleston* and three troopships sailed into Apra Harbor and, without a shot being fired in anger, captured the island. Two days later, Captain Henry Glass, commander of the *Charleston*, and his ships departed for the Philippines to reinforce Admiral Dewey who had defeated the Spanish fleet and was blockading Manila harbour. Captain Glass directed an American citizen to run the island until a government representative arrived, and on January 23, 1899, Commander Edward Taussig, USN, reached Guam to officially take control of the new US possession.

The United States had little interest in Guam and demonstrated no interest in the other Mariana or Caroline Islands. Guam met the Navy's needs for a coaling station and Pacific cable base, and an open coal storage facility was soon constructed on Cabras Island. Limited improvements were made to Apra Harbor. Navy recommendations in 1904, and a number of times later, for a major base with extensive coastal fortifications, were not approved and, as the Navy's need for coal decreased and then disappeared, so did its attention to Guam.

The US Navy, which administered the island, gradually improved the quality of life. Social and health services were expanded and compulsory education introduced. With improved health care came a new growth of population which, by late 1941, had doubled to 20,000.

The island, given its origin as a coaling station, had been established as and remained a Navy responsibility. The Navy assumed a dual role: to operate a naval base and administer civilian government duties. Navy and Marine personnel performed governmental tasks such as medical care, policing, operation of the power plant, and running the bureaucracy. Marines constructed roads and carried out other building projects but gave only limited attention to island defences. There were but a handful of coastal defence guns up to 6-inch emplaced on Guam between 1911 and 1921, but by then permanent emplacements had been constructed on Mount Tenjo and the Orote Peninsula. However, with the non-fortification provisions of the Washington Naval Limitations Treaty, the guns were removed in 1922. Even with the worsening Pacific situation in the late 1930s, Navy requests for fortification and naval base construction went unfunded.

The most significant readiness study, the 1938 Hepburn Board, recommended development of the naval base at Guam and fortification of the island. The Navy, concerned over Congressional resistance, was reluctant to request funds for base development at Guam, and instead only asked for $5 million for harbour improvements, yet this appropriation was defeated in the House of Representatives in 1939. Two years later, it was finally approved with additional funding to make a survey for land airfields and a fuel tank depot. Construction of five fuel tanks was started in May, and the building of a breakwater began in August. During June and July survey work and soil tests indicated a suitable location for an airfield on Orote Peninsula, although work had not started when the Japanese captured Guam in December 1941. The following year the Japanese initiated work on an airfield site exactly where American surveyors had suggested a runway.

Japan landed on Guam three days after the attack on Pearl Harbor (see *After the Battle* No. 38) after softening up the island with bombing attacks on the Marine Barracks, the recently-erected fuel tanks, the Pan American terminal for the China clipper route, and the US Naval Yard. The Japanese invasion force came ashore on Dungca's Beach (to the north of the Americans' Red, Green and Blue Beaches) and also in Agat Bay which was the location of White and Yellow Beaches in the US landing in 1944. *Above:* **The American commander in Guam, Captain George J. McMillin, had his headquarters in the original Spanish Governor's Palace on the Plaza de España in Agana which then became the Japanese military headquarters.**

During October 1941, as the situation in the Pacific worsened, civilian dependents were evacuated. All had departed Guam, except Mrs J. A. Hellmers, wife of a Navy CPO, who was pregnant, by October 17. Mrs Hellmers and her new-born daughter were taken prisoner when the Japanese captured Guam, but were repatriated in the summer of 1942 together with five women Navy nurses taken prisoner at the Guam Naval Hospital.

A warning message of the deteriorating situation in the Pacific was received on December 4 (Guam, east longitude dates). The Island Governor/Navy Commander, Captain George J. McMillin, ordered all classified documents destroyed on December 6, although there was little Captain McMillin could do to prepare the island for war. Its coastal defences had been removed years before, and the military force available consisted of only 153 marines, 274 Navy personnel, and 247 men in Guam military units.

On December 8, Captain McMillin received word of the attack on Pearl Harbor, whereupon he promptly ordered the arrest of Japanese nationals on the island. Moments later, the war came to Guam when nine bombers of the Japanese 18th Naval Air Unit (based at Aslito Field, Saipan) appeared over Guam at 8.30 a.m. The first bombs hit the golf course adjacent to the Marine Barracks. The stick ran across the golf links to the Pan American Airways Hotel at Sumay below the west end of the course. Hitting the kitchen, one bomb produced the first Guam deaths of World War II: two Guamanian workers.

Meanwhile, other aircraft were attacking the minesweeper/patrol ship, the USS *Penguin*, in Apra Harbor. The *Penguin* had the largest-calibre guns at Guam — two 3-inch anti-aircraft weapons — and rotated patrol duties off Apra Harbor along with two converted fishing boats, *YP-16* and *YP-17*. The Japanese aircraft strafed the *Penguin* as she fought back with her 3-inch guns and machine guns, Ensign Robert White, an AA gun crew leader, being hit and killed by enemy machine-gun fire. The outgunned *Penguin* was soon damaged, at which point her commander, Lieutenant J. W. Haviland, scuttled the ship, and led the crew ashore in life-rafts carrying the body of Ensign White.

The Japanese aircraft also strafed the USS *Robert L. Barnes* at her buoy in the harbour. The *Barnes* was an old tanker permanently docked for use as a training ship for Chamorros participating in the mess attendant programme. While damaged, she did not sink and was captured by the Japanese along with one of the YPs which survived the attack. They were both taken to Saipan and the *Barnes* survived the war to be recaptured and sold to a British shipping firm.

Next, the attacking Japanese aircraft strafed and bombed the Navy Yard at Piti. This small base, consisting of only 12 buildings, received limited damage before the raiders turned east to bomb the radio station at Libugon (now Nimitz Hill). The last bombs were dropped on Agana where one direct hit destroyed a house near the Naval Hospital which was the quarters of Radioman First Class George Tweed. Fortunately, Tweed was at work at the naval communications facility at the time.

That afternoon, three Saipanese were arrested after landing on a northern beach. They replied to police interrogation that they had been sent as interpreters for the Japanese who they said would be landing the next day at Dungca's Beach, which is now East Agana. When told of this, Captain McMillin said he believed that it was likely a ploy to get him to move the marines from Apra Harbor to allow unopposed landings there. However, the prisoners' story was substantially correct except for the date of the landings, which took place one day later, and that they did not know of the Japanese Army force that was to land at Agat.

The Japanese resumed their aerial attacks on December 9, returning to the targets of the previous day: the Marine Barracks, Sumay Town with its fuel tanks, the Pan American Airways China Clipper terminal, and Piti Naval Yard. Agana was again on the receiving end of a few bombs. One house near the Plaza de España was destroyed. Debris from the house sprayed the jail and frightened the Japanese nationals inside. They pleaded for their release, but Captain McMillin concluded that they were as safe in the sturdy jail as anywhere else. They were subsequently released by the Japanese invasion forces.

The small and inadequately-armed island defence force readied for the invasion. Most of the marines took up positions at the rifle range and golf course on Orote Peninsula. These were fireblocks on the Sumay-Agat road, the one route from Apra Harbor to Agat and Agana. The positions also had a commanding field of fire over Apra Harbor. Had the Japanese anchored in the harbour the marines could have made it rough, but they were few in number and had no weapons larger than machine guns.

While the marines were familiar with Japanese landing craft (which the Marine Corps had studied in 1937) and landing techniques, they had not assigned any troops to defend potential landing beaches. Even had the decision been made to guard the beaches, there were eight or more possible landing sites, which would have spread a couple of hundred marines with no coastal defence weapons very thin indeed.

Fabiola Calkins stands in for the Japanese sentry in this comparison courtesy of Glenn McClure and his monogram on Guam produced by the B-29 squadron of the Confederate Air Force. The building itself now houses the local museum.

The only marines not positioned at the rifle range on Orote Peninsula were 29 men serving with the 80-strong Guamanian Insular Guard Force at Agana and other island locations. The 274 US Navy personnel remained at their posts, such as the Piti Navy Yard, the radio station, and government facilities including the power plant, hospital, and civil offices.

The Japanese landed at about 4 a.m. on December 10. The initial wave, comprising the Special Naval Landing Force (SNLF) of about 500 men, came ashore at Dungca's Beach. A larger Army force of 5,000 troops — the South Seas Detachment under the command of Major-General Tomitara Horii — landed at Agat. Considering the limited American defence, the landing force was much larger than needed, but Japanese intelligence had estimated the island's defenders as numbering 1,800 men, three times the actual figure.

The SNLF pushed west into Agana, encountering en route a truck-load of fleeing Guamanians. The truck was machine-gunned, killing most of its occupants. As the naval landing force reached Agana, they began to encounter small groups of American sailors and the Insular Guard Force. Effective resistance came as the Japanese tried to enter the Plaza de España in downtown Agana. Fireblocks had been established at the entrances to the Plaza. Pete Cruz and Ben Chargualaf were among the Insular Guard who manned positions at the Plaza. They set up a .30-calibre machine gun near the kiosk and laid deadly fire onto the street in front of the cathedral.

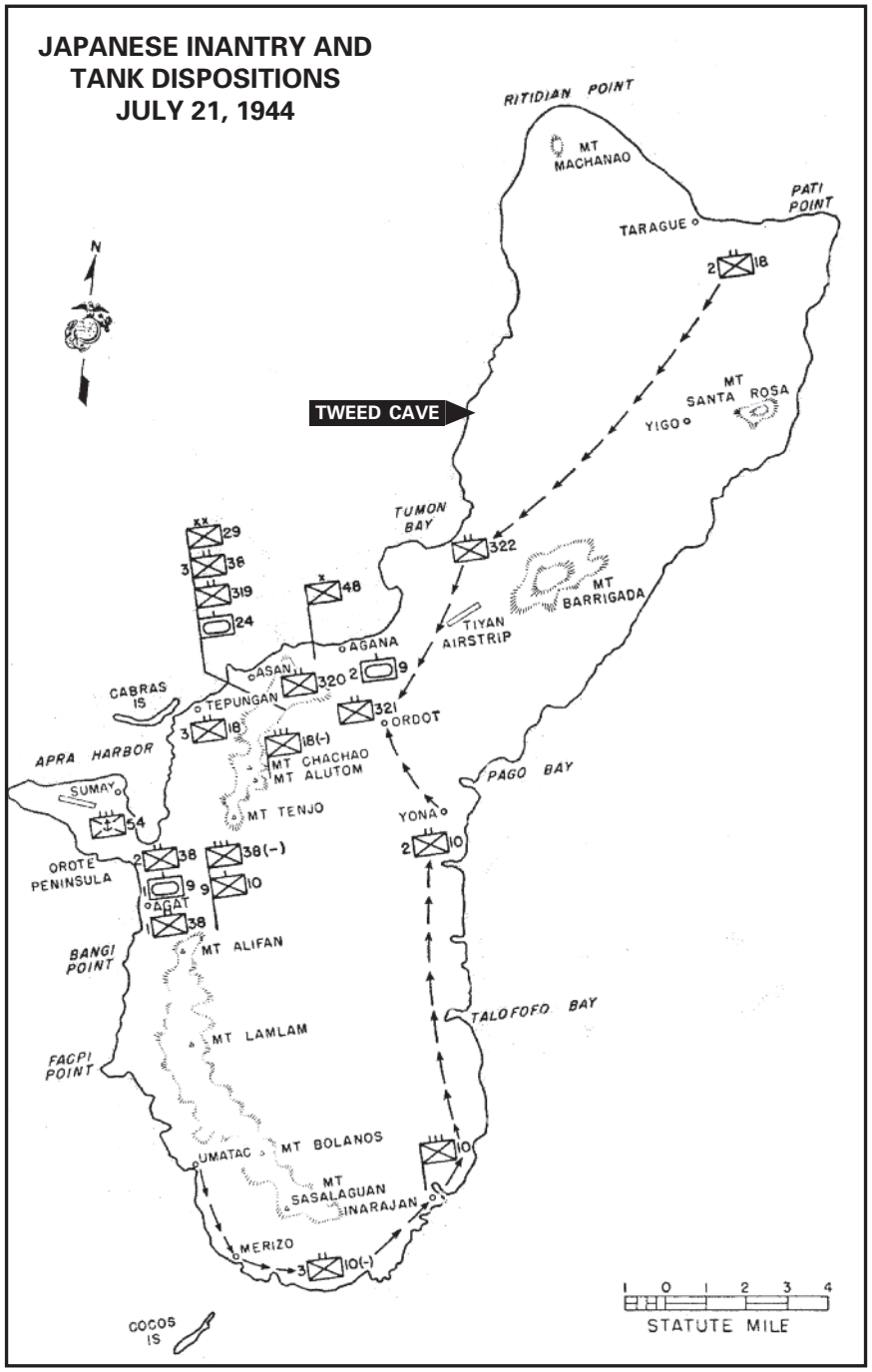
The machine gun defences caused a number of Japanese casualties and halted the advance. The naval landing force retreated and reorganised to resume the attack but before this was launched Captain McMillin had realised the impossibility of defending Guam and the risk of heavy civilian casualties if the fighting continued. He therefore decided to surrender the island at about 5.45 a.m., the horn of an automobile parked on the Plaza being used to signal a cease-fire.

Commander Donald T. Giles, an aide to the Governor, and Chief Boatswain's Mate Robert Lane crossed over to the enemy lines to arrange a surrender. Japanese representatives returned with them to McMillin's office where, after a short discussion, Captain McMillin signed a surrender document. The Japanese flag was raised in front of Government House at about 6.15 a.m. The South Seas Detachment was still making its way from Agat to the Marine Barracks, its objective, but neither it nor the US marines had any opportunity to be involved in the island campaign.

Casualties were relatively light. On the American side, 13 American military, four Guam military, 25 Guam civilians and one American civilian had been killed. Japanese losses were not reported but were probably even fewer.

The American troops were rounded up and held prisoner in buildings around the Plaza de España. Then, on January 10, 1942, they were marched to the Piti Navy Yard where they boarded the *Argentina Maru* bound for prison camps at Zentsuji, Honshu, Japan.

The initial Japanese occupation of Guam included the Special Naval Landing Force and the Army's South Seas Detachment, but the latter left in March 1942 bound for Rabaul. Some 200 Navy personnel of the 54th Naval Guard Force remained to administer the island. The Navy and its civilian affairs officers tried to convince the Chamorros of their place in the Greater East Asia Co-Prosperity Sphere, but it was an unsuccessful effort as brutal acts by the occupiers negated the Japanese claim to have 'liberated' the island.



The first 18 months of Navy rule were tolerable for most Guamanians as most were able to avoid the occupiers. The people were largely left alone, except those suspected of aiding radioman George R. Tweed, who had escaped with five other enlisted Navy men on the day of the invasion. Three of the escapees, L. W. Jones, Albert Yablonsky, and L. Krump, were captured on September 11, 1942, on the east side of the island where they were beaten before being bayonetted to death. Al Tyson and C. B. Johnson were captured soon afterwards and killed. Tweed kept moving and, with the help of numerous Guamanians, remained at liberty right up until the American invasion in July 1944, when he signalled a Navy ship with a pocket mirror and hand-made flags. Those Guamanians suspected of helping Tweed were beaten, tortured and some were executed.

The situation for the islanders changed in February 1944 with the return of the Japanese Army. Schools were closed and forced labour was imposed to supply food, construct two airfields, and build fortifications. Acts of brutality against the Chamorros increased, including the torture and beheading of Father Jesus Baza Duenas, a Chamorro Catholic priest, who was accused of aiding Tweed. He was executed with three others on July 12, 1944.

At the same time, the people were ordered into concentration camps laid out near the sparsely-populated east coast. While the Japanese motive has never been established, it had the positive effect of saving the lives of many civilians by removing them from the pre-invasion bombardment areas. There were some deaths in marching the old and sick to the camps, and there was a horrible fear among the Guamanians that mass executions were planned. However, it seems that the camps were designed simply to remove the people from places from which they could assist the American invasion. Forced Chamorro and imported Korean labourers working on the fortifications were not so lucky and many were summarily executed at the work sites when the Americans landed.

The Army's return to Guam in early 1944 was to strengthen Japanese defences in the western Pacific. In February 1944, the 29th Division of the Kwantung Army, under the command of Lieutenant-General Takeshi Takashina, departed from Manchuria for the Marianas, but American submarines attacked and torpedoed two of the transports, sinking the *Sakito Maru*, with the loss of 1,400 men. In March, additional units including the 6th Expeditionary Force were sent to Guam. Once ashore, the 6th was divided into the 48th Independent Mixed Brigade, and the 10th Independent Mixed Regiment. By July 21, Japanese strength on Guam had reached about 18,500.

Defensive construction on Guam was late and hurried. Coastal defence guns were sited in open revetments with little protection as there was not the time nor the materials to build casemates. Even on the beaches maximum use of trenches and gun pits was not realised, and cave construction was largely limited to shelter caves in the cliffs.

Between Facpi Point and the north side of Tumon Bay — the area where the Japanese anticipated landings — some 50 coastal defence guns were emplaced, comprising 120mm coastal and dual-purpose to 200mm short-barrel, anti-boat guns.

Until the preliminary American bombardment began in mid-June, the Japanese defence plan had been to disperse troops over the entire island with the main defences on the western central shore. The heavy bombardment on this side of the island reinforced the belief that the landings would take place in this area and, accordingly, General Takashima, 29th Division and Island Commander, moved his forces from the south and east coasts to the western side of Guam.

Apart from airfield construction on Orote Peninsula — on the same site already surveyed by the Americans — the Japanese did not begin to build up their garrison on the island until later in 1943. As soon as reinforcements reached the Marianas they went to work constructing island defences. The main ones in Guam were placed on the western coast between Facpi Point and the north edge of Tumon Bay, covering the best landing beaches. Some 50 coastal defence guns, from 120mm to 200mm, were emplaced , most of them in open positions as there was neither time nor materials to build casemates. The guns were sited on the beaches in accordance with the Japanese strategy of beach-line defence. The enemy was to be destroyed before they could get ashore or, if they were able to land, to drive them off the beach prior to the establishment of a beach-head. *Above left:* **A rusting 200mm field piece pictured by Colt Denfeld at Gun Beach (Gognga Cove) near Tumon.** *Above right:* **This 75mm gun position at Gaan Point laid deadly fire on the Marine landing force.**

A 75mm in the jungle of Fonte Plateau, renamed Nimitz Hill after the Commander-in-Chief, Pacific, Admiral Chester W. Nimitz. This is now within the confines of the Naval Air Station.

On Orote Peninsula where the 54th Naval Guard Force had time to carefully plan and construct defences in depth, dual-purpose guns were emplaced to fire anti-aircraft, against targets in Apra Harbour targets and protect the approaches to the peninsula. Hidden in caves and the jungle along Agat Bay on the south shore and above Apra Harbour on the north were machine guns *(left)* **and 37mm and 75mm guns. The Dadi Beach gun positions in particular** *(right)* **laid a devastating barrage on the marines as they tried to advance onto Orote Peninsula from Agat.**

The first phase of Operation 'Forager' began with the landings on Saipan on June 16, 1944 (see *After the Battle* No. 89), the capture of the island after a month's bitter fighting leading to the resignation of the Japanese Premier, Hideki Tojo, and his Cabinet on July 18. Three days later the second phase of 'Forager' began with the assault on Guam (the third phase against Tinian taking place on the 24th). *Above:* **The 3rd Marine Division came ashore at Asan — exactly where the Japanese predicted an invasion would hit them — against defences such as this 200mm emplaced at Asan Point. (USNA)**

The American plan for the recapture of Guam had landings scheduled for June 18, shortly after the assault on Saipan. However, tough resistance at Saipan, and the early use of the floating reserve, the Army's 27th Infantry Division, plus naval engagements in the Philippine Sea, forced a postponement of the invasion of Guam. A new reserve force, the Army's 77th Infantry Division, was assigned to the task on July 6 with the landing date set for July 21, 1944.

The III Amphibious Corps, commanded by Major General Roy Geiger, had the task of recapturing Guam. For this mission, General Geiger had available the 3rd Marine Division, the 1st Provisional Marine Brigade (comprised of the 4th and 22nd Marine Regiments and the 9th and 14th Marine Defense Battalions), with the 77th Infantry Division in reserve. The marine commanders were Major General Allen H. Turnage, 3rd Marine Division, and Brigadier General Lemuel C. Shepherd, 1st Provisional Marine Brigade. Major General Andrew D. Bruce was Commanding General of the 77th Division.

The July 21 landing forces were to come ashore at Asan and Agat beaches. The 3rd Marine Division was to hit the former while the 1st Provisional Marine Brigade was to land at the more southerly Agat, followed by the Army's 77th Division. The Asan beach landings were made without heavy casualties but, once ashore, deadly artillery and mortar fire began dropping from the hills onto the beach. Air strikes against the high ground forced the defenders to take cover, and the invading marines were able to establish a foothold. The break-out from the beachhead met with strong resistance from Chonito and Bundschu cliffs where the 3rd Marine Division found itself up against steep cliffs well defended.

This casemate, minus its gun, is now within the War in the Pacific National Park. The interior steel supports were added by the National Park Service to reinforce the walls of the cave.

Above: **The confused scene on the other landing beach at Agat where the 77th Infantry Division came ashore. (USNA)**

At Agat, the 1st Provisional Marine Brigade and the 305th Regiment of the 77th Division came ashore and had established a 2,000-yard-deep lodgement area by the evening of the first day. The main point of resistance had been an undetected stronghold in two small rock outcrops at Gaan Point which contained two 75mm guns, machine-gun positions, and rifle pits carefully blended into the natural terrain and hidden by trees and grass. These Japanese guns destroyed nine LVTs (Landing Vehicle, Tracked) and measurably slowed the assault.

The Japanese launched counter-attacks that evening, but they were repulsed with heavy casualties for the attackers.

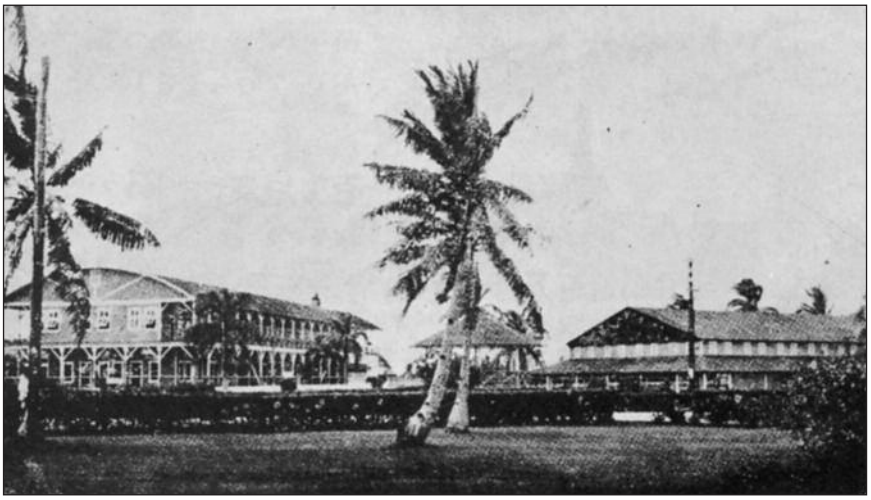
The 3rd Marine Division fought east and west. The drive east was tough, as the 3rd and 21st Marines had to capture Chonito and Bundschu Ridges. Both ridges were steep and covered by machine guns and rifle pits, and the few narrow passages into the Fonte mountains behind the ridges contained machine-gun emplacements. The Japanese staged a wild counter-attack on July 26 which expended much of their strength. After heavy fighting on Fonte Ridge, the next day the 3rd Division was able to push to Mount Tenjo and link up with the 77th Division which had driven north.

Meanwhile, the 9th Marines (3rd Division) had moved from Asan to the Piti Naval Yard and Cabras Island. Advancing along the beach road and the shoreline, they made rapid progress in spite of the difficult terrain and captured both objectives by July 23. Cabras Island was then used as an artillery base for fire against Mount Tenjo and Orote Peninsula.

Right: **The War in the Pacific National Historical Park on Guam comprises six physically separate units. Both landing beaches are included: Asan (Red, Green and Blue Beaches) to the north of Apra Harbor and Yellow and White Beaches to the south at Agat.**

Left: **Major General Andrew Bruce (right), Commanding General of the 77th Division, with his Chief-of-Staff, Colonel Douglas McNair. (USNA)** *Above:* **The narrow coastal strip which comprises the Agat Unit of the park includes caves, bunkers, latrine foundations and more than ten pillboxes. A new Agat village has since been constructed a short distance further south from the original one destroyed in 1944.**

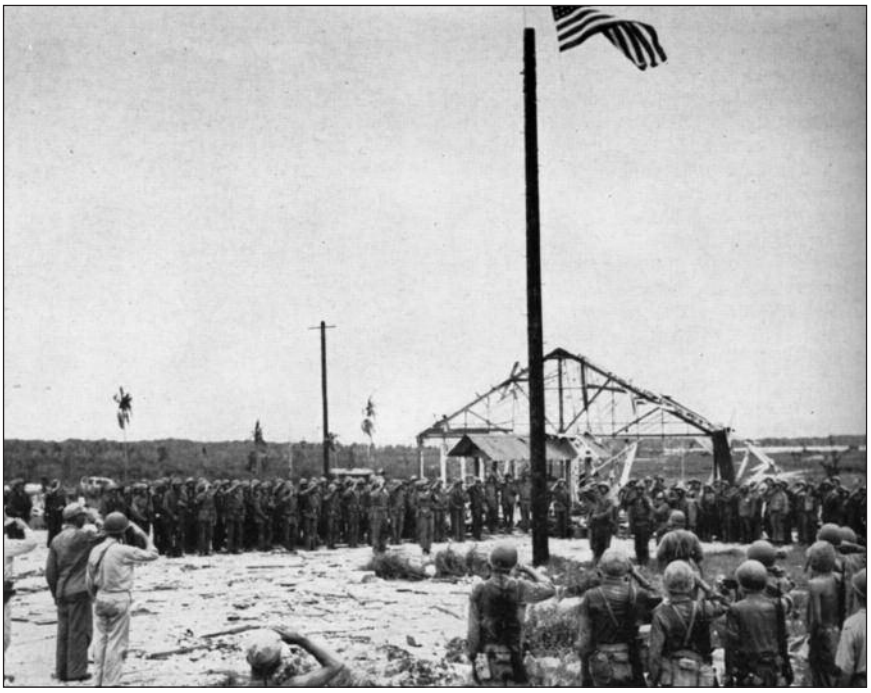
The Marine Corps barracks on Guam lay just east of the airfield. Built in 1921, they were severely damaged during the American bombardment of the Orote Peninsula and were recaptured by the 22nd Marines on July 29.



In the south, at Agat, the 1st Provisional Marine Brigade, reinforced by units of the 77th Division, planned to drive inland and turn north to Mount Alifan and on to Orote Peninsula. While the thrust across Alifan was relatively easy, the capture of Orote Peninsula was tough. The Japanese had constructed well co-ordinated defences on Orote and effectively used natural barriers such as swamps and dense jungle to bolster their defences.

The assault on Orote was launched on July 25 by the 22nd Marines. The regiment entered the peninsula from Agat Bay and immediately ran into a defensive line of pillboxes and camouflaged machine-gun nests. The Japanese counter-attacked on the night of July 25/26 but, with artillery support from Cabras Island, the attack was halted.

Having destroyed the counter-attack, the 22nd Marines, now reinforced with the 4th Marines, resumed their assault on Orote on the morning of July 26. They advanced some 500 yards that day. On the 27th they pushed ahead another 500 to 600 yards and reached the destroyed pre-war Marine Barracks. The next two days were used to clear the remaining tip of the peninsula. Orote was declared secured at 4 p.m. on July 29 with 279 Americans killed and over 2,000 dead Japanese. The American flag was raised at the Marine Barracks, and a pre-war bronze plaque, found in the bombed rubble, erected alongside.



Naturally it was a significant victory for the marines, and their commander, Brigadier General Lemuel C. Shepherd, expressed their feelings as the Stars and Stripes were raised to the sound of *To the Colors* played on a Japanese bugle: 'On the hallowed ground, you officers and men of the First Marine Brigade have avenged the loss of our comrades who were overcome by a numerically superior enemy three days after Pearl Harbor. Under our flag this island again stands ready to fulfill its destiny as an American fortress in the Pacific'.

Left: **The original bronze plaque from the barracks was found in the rubble. General Shepherd stands second left flanked by Lieutenant Colonel Alan Shapley, 4th Marines (minus helmet), and Colonel Merlin F. Schneider, the CO of the 22nd Marines.**

The general commanding the invasion force, Lieutenant General Holland M. Smith, is on the extreme right. *Right:* **The plaque is now mounted near the entrance to the present-day Marine Corps HQ building.**

The best preserved coastal guns on Guam are those at the Japanese battery which was built above Piti village. *Left:* They were discovered still camouflaged with canvas and palm fronds and had not fired on the American landing forces. *Right:* The three 140mm guns can be seen within the 24-acre Piti Guns Unit of the Historical Park.

Marines advancing towards Agana pass Pigo Cemetery near Adelup Point which was badly knocked about in the pre-invasion bombardment.

The capture of Orote on July 29 completed the first phase of the invasion of Guam. Now the assault could turn to securing the remainder of the island. General Geiger believed that the surviving Japanese, probably numbering some 10,000, had now moved to the northern end of the island where there was a road network and commanding jungle positions to the rear of cultivated land which could serve as deadly fields of fire against advancing troops. Geiger was not willing to launch a drive to the north until he was absolutely certain that the south had been abandoned, otherwise he left open the opportunity for a trap between emplaced soldiers in the north and an enemy thrust from the south. However, reconnaissance patrols by the 77th Division confirmed that the Japanese had retreated to the northern area, and on July 31 the northern pursuit was launched.

The plan was for the 77th Division to drive north up the eastern side of Guam, while the 3rd Marine Division pushed up the western side. Meanwhile, the 1st Provisional Brigade, tired and hurt by the battle for the Orote Penisula, went into corps reserve.

By now, the Japanese were too disorganised to make effective use of the defensive potential of the northern area and the 3rd Marine Division and the 77th Division advanced against unco-ordinated defences. The 3rd Division captured Tiyan Field on August 3, while the 77th Division encountered some stiff resistance at Mount Barrigada. The Army moved north quickly, only temporarily slowed by fighting in Yigo. On August 8, the 77th attacked the final north-east stronghold of Mount Santa Rosa, while the marines were at Ritidian Point on the north-west tip. Two days of mopping up followed, and the island was declared secure on August 10, 1944.

However, there were still thousands of Japanese unaccounted for, and the jungle was subjected to systematic searches by marines. Later, a Local Security Patrol Force of Guamanians with Marine assistance was established to continue the process and patrols killed about 80 Japanese a day during the remainder of August. As late as October, a major sweep by the 3rd Marine Division accounted for another 100 killed but still many Japanese remained at large in the jungle. However, by the spring of 1945, hunger and illness began to take their toll, encouraging the remaining organised groups to come in. On June 11, Major S. Sato surrendered his group of 34 men, and Lieutenant-Colonel Hideyuki Takeda and 74 men surrendered on September 4, more than a year after the invasion.

Today a metalled highway passes the restored cemetery.

Above left: **One of the last groups of Japanese soldiers, accompanied by their dog, walk into American lines. The Americans also used dogs during the battle to act as sentries and inspect caves. Over 20, including four corporals and 16 privates, lost their lives and are now buried in the War Dog Cemetery at Yigo (see back cover).** *Above right:* **But not all the Japanese gave themselves up! Shoichi Yokoi became a national hero after hiding in the jungle for 26 years after the end of the war. His first words when he arrived back in Tokyo were: 'It is with much embarrassment that I return' and his words soon became a popular saying in Japan. He was spotted fishing just 20 miles from Agana wearing trousers made of sacking and a shirt he said he had made from the bark of trees. Mr Yokoi returned to Japan feeling that he had failed to serve his Emperor even though he had stuck to the Imperial Army's code of 'Never surrender'. He died aged 82 in September 1997.**

Even so, not all the stragglers had been killed or captured. On September 25, 1951, four Japanese were surprised on a northern beach, of whom three fled and one was captured. He then led police to a cave occupied by four more stragglers who were persuaded to surrender. Three more came in from cave hiding positions that month. In 1960 Tadeshi Ito and Bunzo Minegawa surrendered and were returned to Japan. Even more amazing was the capture of Sergeant Shoichi Yokoi on January 24, 1972, but some local residents say that he was not the last. During the 1980s there was a flurry of activity following evidence of a possible Japanese in the thick jungle of the Naval Magazine wildlife preserve.

Some 1,250 Japanese surrendered while an estimated 18,000 had been killed. The latter were hurriedly buried, either in convenient bomb or shell craters or excavations dug by bulldozers. Americans deaths for the recapture of Guam totalled 2,124. *Centre:* **This is the 77th Infantry Division Cemetery near Gaan Point. It was a temporary burial ground and the remains were transferred either to the National Memorial Cemetery of the Pacific established in 1948 or Stateside cemeteries.**

The site of the old American cemetery near Agat as it looks today.

Right: **When Agana, the capital of Guam, was captured there were only about 50 buildings left intact so when the Seabees started work to create the military government headquarters, they found it easier and faster to bulldoze damaged buildings and erect Quonset huts than to repair structures. Today only about ten pre-war buildings survive. (USNA)**

For the first few days of the American invasion, Seabees and Marine engineers were committed to supporting the landing effort, often serving as infantry. However, even before the island was secured, construction of roads and airfields was begun. On July 29, the 2nd Marine Engineer Battalion went to work to repair the Japanese fighter strip on Orote, and two days later a Navy Avenger aircraft landed but stayed only three minutes because of sniper fire. A squadron of marine F4F Hellcat night fighters arrived on August 4. The Japanese field at Tiyan, near Agana, was repaired and became a Naval Air Transport Service and Army Transport Service airfield.

The major construction projects were for naval facilities and three B-29 airfields. Army engineers and Seabees built the airfields: North and Northwest Fields and Harmon Depot Field, the latter being the largest B-29 repair base in the Pacific. North Field, built by Army engineers, had one runway completed by February 2, 1945, and three weeks later the first B-29s from Guam lifted off this field for an attack on Tokyo. Seabees and Army engineers worked together to construct Northwest Field, with one runway ready for use by June 1, 1945.

There were many other construction projects to convert Guam into a B-29 and forward naval base. Harbour facilities were rebuilt and new piers constructed. Roads had to be rebuilt and thousands of barracks, hospital wards and warehouses erected. Housing also had to be provided for about 18,000 displaced civilians, with civilian camps being built at Agana, Asan, Agat and Ylig River.

In 1944-45 there was a population explosion. On August 31, 1945, there were 21,838 Guamanians, 65,095 Army, 77,911 Navy, and 58,712 Marines, all residing on Guam. The island had for ever been altered. While the military population would be cut drastically after 1945, a number of bases were to remain ready to defend the Pacific-Asian Theater, and the Naval Operating Base on Orote Peninsula (now Naval Station); Naval Ammunition Depot (now Naval Magazine); Anderson Air Base (the former North Field); the Naval Communications Station and Naval Headquarters on Nimitz Hill have all survived to the present day as important active military bases.

The debris from the town was pushed onto the Paseo de Susana, expanding the harbour. Colt Denfeld matched the shot from San Ramon Hill.

Other villages — Agat, Asan, Santa Rita and Sumay — had also been destroyed during the recapture of the island. They too were bulldozed and new towns built in their place, except for Sumay on Orote which was not resettled. The village ruins were cleared to make room for the Port Director's camp in the Naval Operating Base. *Left:* **This is the church of Our Lady of Guadelupe in Sumay.** *Right:* **It was never rebuilt, the site now marked by this cross within the Naval Station.**

Left: **West Agana was bulldozed by the 25th Naval Construction Battalion to establish its camp. (USNA)** *Right:* **Today commercial businesses stand on Marine Drive . . .**

Guam Today

While there are some significant war relics existing on Guam, a number of events have conspired to remove many reminders of the battle. The American military construction in the immediate post-war period cleared many battlefields of war features as construction for over 200,000 military personnel required a great deal of land.

The military construction programme totalled 130 installations. Many of these camps or facilities were sited on battlefields; the 5th Naval Construction Brigade set up headquarters on the Adelup Point battle area; the 25th Naval Construction Battalion cleared the former village of Aniqua (West Agana); the Naval Operating Base on Orote Peninsula meant the destruction of fortifications and defences there, and camp construction at the invasion beaches led to the removal of further battlefield debris. Thereafter, a number of these camps gave way to commercial development following a military run-down in 1946 and again in 1949-50.

During the reduction of military strength in 1946, a number of camps were closed and the Quonset huts sold or contracts let for their removal as scrap. Thus, not only had battlefield features been removed, but the immediate post-battle construction was also fast disappearing. Some of the hospital camps were converted into family housing as military dependants were again allowed to accompany their spouses to Guam. In 1950, another large reduction in troop strength was carried out with the closing of major camps such as the Marine Camps of Witek (at Ylig) and Quezon at Pago Bay. Quezon became the University of Guam, but post-war construction has removed all the original Quonset huts and all traces of the Marine camp. Camp Witek is now covered with jungle, but at least in the jungle one can still find the concrete bases from the Quonset huts and other military debris.

Some camps were re-used with their Quonsets serving new owners. The Navy 5th Service Depot at Maite which comprised 100 elephant Quonset huts (measuring 40ft×100ft) was closed in 1949 and a high school, auto-wrecking yards, scrap-yards, stores, a bakery, and construction firms moved into the buildings. Over the years, many of the Quonsets were torn down or blown away by typhoons, but as late as 1985 a number of these still remained to be seen. Today, however, this is a commercial area with modern concrete buildings.

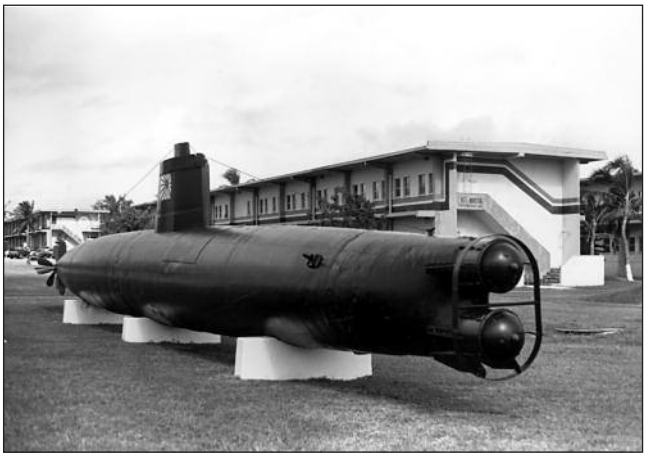
During the 1950s, many war relics that had survived the immediate post-war clean-up and base construction were collected for scrap. Dealers from Taiwan visited the Micronesian islands to recover guns, vehicles, corrugated iron and other scrap metal. A few guns hidden in the jungle or on private property where the owner would not allow removal were the only ones missed by the scrap drive.

On November 11, 1962, Typhoon Karen struck Guam with winds of up to 180 miles per hour. Many of the Quonsets which had not already been removed were destroyed, and super Typhoon Pamela in 1976 completed the island renewal process. What few Quonset huts still survived have now disappeared, being replaced by modern buildings in the economic boom associated with tourism.

Battlefield artifacts are found today in the undeveloped areas which are usually covered with dense jungle growth. When the areas which form the US National Park Service's 'War in the Pacific National Historical Park' were originally surveyed by the author in 1979, thousands of relics were found in the jungle. These ranged from Japanese guns and pillboxes to US dog tags. One unique discovery in the old Agat area was an American canteen with a map of the owner's Pacific islands campaign and his name, 'Lucky Gene Cole'. The marine had not been so lucky, having been killed near this spot.

. . . but on the Plaza de España the old gazebo has been preserved. The foundations of the ruined Government House have also been retained, although hidden by the trees in Colt's comparison, as has the base of the old flagpole.

Extant remains on Guam. This Corsair lies in the jungle near the old Orote airfield built by the Japanese but its precise history or provenance is not known. The abandoned airfield came into its own again in 1975 when it became a temporary camp to house some 50,000 refugees from Vietnam.



This Japanese Type A midget submarine is believed to have run aground on Togcha Beach on the east coast in August 1944. It was originally exhibited at the nearby submariner's rest station, Camp Dealey, but when that closed in 1951 it was moved to its present location at the Naval Station.

In recent years, there has been a fantastic development of the island in response to growing tourism from Japan. New hotels and tourist-related facilities have been constructed and battlefield areas forever lost. There is an active historic preservation office which has saved many war relics and battlefield areas and also the US National Park Service is working to preserve the Asan and Agat beach landing areas and other battlefields as part of the Historical Park. There is a limited effort to remove modern intrusions from the Asan landing beaches.

The Agat invasion area is one of the better preserved battlefields as it is away from the more-intensely developed areas to the north. The Gaan Point position with its two pillboxes, and shelter caves on the reverse side, is still intact and protected as part of the Park. The landing beach is clear of wartime debris and the spot where General Bruce and Colonel Douglas McNair, Chief-of-Staff, 77th Infantry Division, were photographed is today frequented by people fishing and Japanese tourists. Colonel McNair, son of Lieutenant General Lesley J. McNair, was killed in action on Guam on August 6, 1944, only two weeks after the death of his father who was hit by a bomb blast in Normandy on July 25, 1944.

All but two pillboxes of the Japanese beach defences at Gabgab Beach, Orote Peninsula, were destroyed when this beach was converted into a recreation centre in March 1945. A few relics were missed in the unimproved areas of Orote, now jungle-covered. In the cliffside above Sumay are Japanese gun and shelter caves, a Type 96 25mm anti-aircraft gun, and the pre-war bombed buildings of the Commercial Pacific Cable Company.

Foxholes and battle debris can still be found on Guam's interior mountains which are yet undeveloped, Mount Tenjo being one example where foxholes with ammunition and military gear can be seen. However, a number of these mountain battlefields are undergoing development and a large condominium-resort in the Manenggon Hills threatened a dug-in Japanese Type 95 tank left from the battle. To save the tank it was relocated a short distance away (see *After the Battle* No. 74).

Of 50 coastal defence guns emplaced in Guam, only four remain in situ. Three of them are 140mm guns above Piti village where they had been well camouflaged by palm fronds and canvas covering. They were undamaged in the bombardment and abandoned. When the marines advanced to Cabras Island, they attacked and damaged two of the guns. Two 200mm short-barrel, anti-boat guns in caves above Dungca's Beach were only recently removed to make way for the Onward Agana Hotel. One is now on display beside the hotel swimming pool. The fourth coastal defence gun still in place is a 200mm anti-boat gun in a crevice at Gun Beach on Tumon Bay. There are also two more 200mm anti-boat guns which have been removed from their original emplacements. One is now displayed at Gaan Point and the other in the Naval Magazine. Other weapons to be seen in Guam are two 47mm anti-tank guns at the Agana jail, two more at the Stell Newman Visitors' Center at Asan, and a shot-up 47mm at the Marine Barracks, Orote. A 120mm Type 10 gun stands in the grounds of the Hilton Hotel. Two more Type 10s found in the jungle in the Tumon area are held by the Black Construction Company.

All the World War II naval ships remaining at Guam are of the sunken variety. The oil tanker *Robert L. Barnes* was towed to Saipan by the Japanese, but recovered at the end of the war and sold to a British firm, sailing as the *Fortune* and *MTS No. 2* from 1945 to 1949 when it was scrapped. For the scuba diver there are some worthwhile dives. In Apra Harbor are the *Nichiyo Maru*, the *Tokai Maru*, *Kitsugawa Maru*, and a Val dive-bomber. Local dive shops have complete details on how to dive on these wrecks. There is also a crashed Val near Sergeant Shoichi Yokoi's cave, in reality just a dug-out. The hand-made cooking, fishing, and personal items of Sergeant Yokoi are displayed in the Guam Museum in the garden of the Plaza de España. The museum has a few Japanese rifles on display, as does the Flores Public Library in Agana.

Asan Point, which included a number of gun positions, was developed into a civilian workers' camp after the battle. During the Vietnam War the camp was converted into a hospital and in 1975 a camp for Vietnam refugees. Since 1980 it has been a part of the War in the Pacific Park, the former camp buildings having been removed. On the west side of the point is an empty emplacement for a 200mm anti-boat gun and three other gun positions.

Northern battlefields at Barrigada, Mount Santa Rosa, and Yigo have been cleared for housing, commercial development, and golf courses. The last Japanese command post caves are now part of the South Pacific Memorial near Yigo where Lieutenant-General Hideyoshi Obata died at the end of the battle.

One unusual war feature is the relocated War Dogs' Cemetery near Yigo. Moved here from Asan, it contains the graves of 24 dogs which were used during the American invasion for scouting, messenger and sentry work and cave clearing.

This 47mm anti-tank piece was pulled out of the Japanese defence line near the old Marine Barracks and is now displayed within the grounds of the new barracks.

George R. Tweed was a US Navy radio operator living in Agana when the Japanese invaded Guam on December 8, 1941. He was one of six American sailors who evaded capture when Captain McMillin surrendered the island but the other five were soon caught and executed. *Left:* **Tweed (back row, left) was hidden by Guamanians, in particular the Johnston family led by Agueda (front row, third from left), but during his last 21 months he found refuge in a cave at Pagua Point. Numerous Chamorros suspected of hiding or aiding Tweed were arrested, tortured and even executed like Father Jesus Duenas who was beheaded in July 1944, just days before the Americans returned. Yet, in spite of the severe reprisals for sheltering him, Tweed's continuing freedom became a symbol of resistance against the Japanese.** *Right:* **Tweed's hiding place being investigated in May 1947. The cave proved to be little more than a crevice in the cliff from where he had a clear view of the sea** *(below)* **and from where he signalled to US ships prior to the recapture of the island. (David T. Lotz)**

After the war, the body of Father Jesus Baza Duenas was recovered from the execution site in Tai and buried beneath the altar of Saint Joseph's Church in Inarajang, the village that Father Duenas served during the Japanese occupation.

Across the road from Gaan Point is the site of the 77th Infantry Division cemetery. Today, an apartment house and homes occupy the grounds. The American military cemeteries at Agat and Asan were removed in 1948 with the remains transferred to the Punchbowl in Hawaii or local home-town cemeteries. Guamanians lobbied for the retention of the cemeteries, but this effort was unsuccessful given the distance and difficulty for next-of-kin to travel to the then-remote island.

The US airfields are all within military areas. Northwest Field is abandoned within Andersen Air Force Base. North Field has become the Andersen AFB runway and main base area. Harmon Depot Field is abandoned with access unrestricted and is now the Harmon Industrial Park. Pieces of the runway survive and are in use as a roadway or foundation for buildings. The Japanese Tiyan Field was expanded into Brewer Field. The Japanese constructed Orote runway which was enlarged and rebuilt as Naval Air Base, Orote, which was abandoned in 1946 because of dangerous crosswinds. It was used in 1975 as a tent city for Vietnam refugees but has sat empty ever since.

Japanese shelter caves can still be found in the cliffsides of the Agana hills. Caves can be explored in Agana, above Agat, and the impressive Gumayas Cave located along the Togcha river valley. During World War II, the Gumayas Cave was used as a church by the people of Talofofo, but with the American invasion it was taken over by the Japanese for use as a hospital. Nearby is a Japanese-constructed defensive cave. Directions as to how to find these caves and details of other hikes to World War II sites are available from the Guam Visitors' Bureau. Some sites, such as Radioman Tweed's hiding place and a few sites mentioned above, are on US bases with restricted access.

The cave was still very overgrown in 1983 when the National Park Service recommended it to be placed on the list of significant sites which lay outside the boundaries of the actual War in the Pacific Historical Park.

25 MARINE WAR DOGS GAVE THEIR LIVES LIBERATING GUAM IN 1944. THEY SERVED AS SENTRIES, MESSENGERS, SCOUTS. THEY EXPLORED CAVES, DETECTED MINES AND BOOBY TRAPS.
SEMPER FIDELIS
KURT YONNIE KOKO BUNKIE
SKIPPER PONCHO TUBBY HOBO
NIG PRINCE FRITZ EMMY
MISSY CAPPY DUKE MAX
BLITZ ARNO SILVER BROCKIE
BURSCH PEPPER LUDWIG RICKEY
TAM (BURIED AT SEA OFF ASAN POINT)
GIVEN IN THEIR MEMORY AND ON BEHALF OF THE SURVIVING MEN OF THE 2nd AND 3rd MARINE WAR DOG PLATOONS, MANY OF WHOM OWE THEIR LIVES TO THE BRAVERY AND SACRIFICE OF THESE GALLANT ANIMALS
BY WILLIAM W. PUTNEY DVM C.O. 3rd DOG PLATOON
DEDICATED THIS DAY 21 JULY 1994